Volume 22, Number 24, December 31, 1968

NUCLEAR SCIENCE ABSTRACTS

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Index References

All index entries refer the reader to volume and abstract number:

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FOURRIER, Alain
  Radioactive chain of mass number 189,  21:10023
```

Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

```
MONTH, M.
  Theory of gradient perturbations in AGS,  21:9872 (BNL-
    10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic
    form factors of the deuteron,  21:9744
```

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

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SHEEP
  radiation dosimetry in, measurement of lethal dose of x,
    21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x,
    21:8905(R) (AD-631189)
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SHELTERS
  construction of, for civil defense,  21:8838
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  determination of configuration of, for ventilation,
    21:8779(R) (AD-629928)
  equipment for fallout, minimal requirements of,
    21:8782(R) (AD-631424)
  evaluation of fallout, for fire and air blast damage,
    21:8560 (URS-658-3)
  fire resistance of components of, evaluation of,
    21:8789(R) (AD-642241)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

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UNION CARBIDE CORP., OAK RIDGE, TENN.  Y-12 PLANT.
  Mixing and sampling enriched 235U fluids in cylindrical
    storage containers,  21:8500 (Y-1561)
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Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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TID-
  3311(Suppl.  21-8567   Dep. mn. CFSTI $3.00 cy, $0.65 mn
    2)
  22298        21-9915   Nucl. News, 9: No. 12, 17-21 (Dec.
                           1966)
  22298        21-9914   Nucl. News, 10: No. 1, 17-20(Jan.
                           1967)
  23267        21-9702   Phys. Rev., 152: 1171-82(Dec. 23,
                           1966)
  23267        21-8498   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23420        21-8764   Lancet, 2: 672-5(Sept. 24, 1966)
  23474        21-8528   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23478        21-8641   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23482        21-9471   Dep. mn. CFSTI $3.00 cy, $0.65 mn
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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 50965, 51043, 51056, 51228, 51438, 51616, 51857, and 52478.

50902 (ANL-7425, pp 193-7) ANALYTICAL RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

Determination of burnup of fast reactor fuels by photometric titration of total rare earths or x-ray spectrometric determination of rare earth fission products is discussed. Feasibility studies of fuel failure detection included trace elements analytical techniques and tag confirmation study. (M.C.G.)

50903 (BNWL-821) FAST FLUX TEST FACILITY CHEMICAL ANALYSIS LABORATORY PRELIMINARY DESIGN STUDY. Scott, F. A.; Jarosch, J. F.; Barton, G. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 128p. Dep. CFSTI.

Results are presented of a preliminary design study scoped to identify the analytical chemistry needs anticipated for support of Fast Flux Test Facility (FFTF) operations, survey the current technology that pertains to those needs, select promising analytical methods, specify the facilities needed for application of these methods, and delineate areas of analytical technology that need further research and development to assure that the FFTF analytical requirements will be fully satisfied. The equipment and procedures described do not represent final selections for use, but are representative of the present state-of-the-art. The components are described and safety considerations are discussed. A state-of-the-art review is presented for determination of oxygen, carbon, hydrogen, and nitrogen, and for sample dissolution, chemical separations, spectrophotometric determinations, emission spectrographic determinations, radiochemical determinations, unshielded sodium analysis, and maintenance. (M.C.G.)

50904 (NP-tr-1687) NITROGEN DETERMINATION IN CERAMIC URANIUM COMPOUNDS. Naoumidis, A.; Nickel, H.; Rottmann, J.; Stoecker, H. J. Translated by G. Burger (Atomic Energy Research Establishment, Harwell, Eng.), from Z. Anal. Chem., 226: 175-92(1967). 22p. Dep. UK.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 17574.

50905 SPECTROPHOTOMETRIC STUDY OF THE REACTION OF RHENIUM AND MOLYBDENUM WITH FERROCYANIDE. Tarayan, V. M.; Vartanyan, S. V. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Khim. Nauki, 20: 179-83(1967). (In Russian).

A method for the determination of Re in Mo concentrates is based on the formation of complexes of Re(V) and Mo(V) with $Fe(CN)_6^{4-}$ in 6 N HCl in the presence of $SnCl_2$. Under these conditions, Re(V) forms a complex with an absorption maximum at 440 to 470 nm while Mo(VI) is reduced to Mo(V), which forms a similar complex with negligible absorption in this wavelength range. A 0.5 to 1 g sample of the Mo concentrate is mixed with 1.5 to 3 g of CaO and 0.2 g of $KMnO_4$, the mixture is covered with a thin layer of CaO and heated for 1.5 to 2 hr at 650°C. The product is boiled with ≈50 ml of H_2O for 30 min, filtered, and the filtrate diluted to 100 ml. The solution for determination of the Re is prepared by adding to 10 ml of this diluted filtrate sufficient concentrated HCl to make the final solution 6 N HCl, 0.5 ml of a 5% aqueous solution of $K_4Fe(CN)_6$, and 1 ml of a 10% $SnCl_2$ solution. The solution is diluted to 25 ml, and after 30 min the extinction is measured at 440 to 470 nm. (Anal. Abstr.)

50906 DETECTION OF HEAVY METALS IN THE SKIN IN ARGYROSIS BY MEANS OF NEUTRON ACTIVATION ANALYSIS. Schroepl, F. (Univ., Wuerzburg, Ger.); Oehlschlaegel, G.; Drabner, J. Arch. Klin. Exp. Dermatol., 231: 398-407(1968). (In German).

A method for assay of Ag, Cu, Zn, and As, in human skin in metal-induced dermatoses, was developed. Pieces of skin wrapped in polyethylene foil were irradiated in a reactor and the ^{110m}Ag, ^{64}Cu, ^{65}Zn, and ^{76}As resulting from (n,γ) reactions were counted. A description is given of use of the method in a woman with argyrosis. The patient claimed that the pigmentation of her skin had been caused by working with an insecticide containing Cu and As. However, an increased (2000-fold) Ag content of the skin was found by neutron activation analysis. This method provided precise results and was therefore suggested as useful for differentiation between various types of metal deposits in the skin, which cannot be achieved by histochemical investigations. In histologic studies a great affinity of the Ag granules was found for the zones of so-called senile elastosis. This findings probably explained the macroscopic pattern (mainly areas exposed to sun) of pigment distribution in the case described. (BBB)

50907 ANALYSIS OF IMPURITIES IN VERY PURE METALS BY ACTIVATION ANALYSIS METHODS. Albert, Ph. (Centre d'Etude de Chimie Metallurgique, Vitry, France). Ann. Mines, No. 4, 24-52(Apr. 1968). (In French).

Methods of activation analysis in use at the Vitry Center are described. In pure Al the sum of all elements detected by neutron irradiation was 0.06 ppM; the amount of 0 found by analysis with $^3He(II)$ was 0.1 to 0.2 ppM. The sum of the detection limits not detected by neutron activation was 0.25 ppM; those determined by γ photon activation (C, N, F) were about 1 ppM maximum. Mass and emission spectrometric analysis showed that elements not detected by activation analysis were less than 0.15 to 0.4 ppM. Recrystallization of Al is influenced by very dilute impurities. Differences in impurity levels measurable in different samples were of the order of 0.1 to 0.2 ppM (dosed impurities) and the sums of detectabilities of all other elements not detected by activation or mass spectrometry is on the order of 1 to 2 ppM. (BBB)

50908 TOTAL-BODY CALCIUM BY WHOLE-BODY NEUTRON ACTIVATION: NEW TECHNIQUE FOR STUDY OF BONE DISEASE. Chamberlain, M. J.; Fremlin, J. H.; Peters, D. K.; Philip, Helen (Univ. of Birmingham, Eng.). Brit. Med. J., 1: 581-3(June 8, 1968).

The feasibility of whole-body neutron activation analysis, for the determination of total-body Ca, was investigated in experiments on phantoms, cadavers, and 3 living subjects. A fast neutron flux of 3×10^5 neutron/cm^2/sec at 2 m with a mean energy of 3 MeV (range of 0.1 to 8.0 MeV) was used for the irradiation. By using a polyethylene phantom containing calcium phosphate, the slow neutron flux at different depths was measured by the activity in In foils. The results established that: uniformity of irradiation of the skeleton would be expected if the subject were irradiated from 2 opposite directions, provided that a suitable layer of hydrogenous material surrounded the skeleton to provide partial moderation of fast neutrons; and adequate counting rates of ^{49}Ca should be obtained with radiation doses of 1 Rem. Experiments on cadavers and living subjects established conditions of safe and uniform irradiation. Measurements of ^{49}Ca were made at 7 and 14 min after activation. The $^{49}Ca/^{24}Na$ ratio was used to provide a measure of body Ca. Total-body radiation doses ranging from 1400 to 1700 mRem were recorded and are well within the permissible limit of 3000 mrem/3 calendar months for workers

occupationally exposed to ionizing radiation. It was found that the method is safe, and that the results are reproducible. This technique should be useful for diagnosis and management of metabolic bone disease. (TSS) (BBB)

50909 TOTAL-BODY SODIUM BY WHOLE-BODY NEUTRON ACTIVATION IN THE LIVING SUBJECT: FURTHER EVIDENCE FOR NONEXCHANGEABLE SODIUM POOL. Chamberlain, M. J.; Fremlin, J. H.; Peters, D. K.; Philip, Helen (Univ. of Birmingham, Eng.). Brit. Med. J., 1: 583-5(June 8, 1968).

Whole-body neutron activation carried out in 3 normal male subjects showed a consistent and substantial difference (~17%) between activable and exchangeable Na. Values for activable Na were considerably lower than those for whole-body Na based on chemical analysis of cadavers. The activation and counting procedures were described in an accompanying article on total-body Ca. A 68-kg polyethylene phantom (standard man) containing 74.9 g of Na as NaCl dissolved in 57 liter of water was separately activated under comparable conditions except that the irradiation time was increased to 30 min to facilitate counting and the irradiation was carried out from one direction only. Fast neutrons were moderated by a wooden coffin. The activities produced in suitably placed In foils were taken as a measure of neutron flux. The ^{24}Na produced from ^{23}Na by neutron capture has a half-life of 15 hr and 2 γ emissions of 1.38 and 2.76 MeV. Sodium activities were based on measurement of the higher peak in the energy band 2.58 to 2.92 MeV. Counting was started 3 hr after activation, when the short-lived isotopes also produced during activation had decayed away. Counts were repeated 3 times in the first 30 hr, and the initial ^{24}Na activity was found by extrapolation to time zero. The counting efficiency of the whole-body counter for ^{24}Na was measured in the phantom and in the 3 subjects after injection of 2 μCi of ^{24}Na on a separate occasion. The 24-hr exchangeable Na was measured a few days later by conventional isotope dilution techniques using 20 μCi of ^{24}Na. The results, which showed a discrepancy between total-body Na determined chemically and exchangeable Na, provided evidence for a nonexchangeable Na pool. (BBB)

50910 DETERMINATION OF IMPURITIES IN MOLYBDENUM AND TUNGSTEN BY ACTIVATION ANALYSIS. Doege, H.-G.; Grosse-Ruyken, H. (Institut fuer Metallphysik und Reinstmetalle, Dresden. Technische Univ., Dresden). Isotopenpraxis, 4: 262-8 (July 1968). (In German).

Procedures are given for determination of trace amounts of phosphorus, cobalt, chromium, iron, zirconium, hafnium, tantalum, and thorium in molybdenum and tungsten. The samples (0.1 g) are irradiated in a neutron flux of 2×10^{13} neutrons/cm^2 sec for 250 hr. After a cooling time of 10 days the impurities are separated from the matrix and from each other by coprecipitation and ion exchange chromatography. Limits of detection are between 0.5 and 0.01 ppM. (auth)

50911 ANALYSIS OF URANIUM ALLOYS BY ATOMIC ABSORPTION. Baudin, G. (Commissariat a l'Energie Atomique, Saclay, France); Normand, J.; Fijalkowski, J. Spectrochim. Acta, Part B, 23: 587-95(Sept. 1968). (In French).

The analytical procedure used to determine iron and aluminum in SICRAL type uranium alloys, containing Al 500 to 1000×10^{-6} and Fe 50 to 500×10^{-6}, without preliminary separation, is described. The sulfuric acid solution was sprayed in an acetylene–air flame for Fe, on a nitrous oxide–air flame for Al. The influence of the combustive–combustible ratios was studied for each flame. It is shown that the presence of uranium has no influence in the case of certain flame compositions. (auth) (UK)

50912 REACTOR-NEUTRON FISSION YIELDS OF ^{232}Th. Harvey, J. W.; Clarke, W. B.; Gorman, D. J.; Tomlinson, R. H. (McMaster Univ., Hamilton, Ont.). Can. J. Chem., 46: 2911-16(Sept. 15, 1968).

Mass spectrometric methods and a Ge(Li) γ detector were used to obtain reactor-neutron (>1 MeV) fission yields of ^{232}Th. The results have been combined with earlier mass spectrometric and radiochemical work. (auth) (Canada)

50913 ANALYSIS OF LOW LEVELS OF RADIOACTIVITY IN SAMPLES FROM THE AQUATIC ENVIRONMENT. Dutton, J. W. R. (Fisheries Radiobiological Lab., Lowestoft, Eng.). Proc. Soc. Anal. Chem., 5: 186-7(Sept. 1968).

Application of the technique of γ-spectrometric analysis is reviewed, employing a NaI(Tl) crystal coupled to a photomultiplier. Limitations of the technique for analysis of environmental materials are discussed. The necessity in some cases for chemical separations is also discussed, and the determination of ^{55}Fe, ^{65}Zn, ^{60}Co, ^{110m}Ag, ^{134}Cs, ^{137}Cs, and ^{40}K in oysters collected near a nuclear power station outfall is given as an example. Other examples mentioned are ^{90}Sr in the presence of large amounts of Ca and Mg. The analysis of seawater for radioactivity is also mentioned. (UK)

50914 LABELING AND RADIOPURITY OF LIPIDS. Snyder, Fred; Piantadosi, Claude (Oak Ridge Associated Univ., Tenn.). Advan. Lipid Res., 4: 257-83(1966).

Methods of labeling lipid molecules with radioelements by organic synthesis, biosynthesis, and isotope exchange techniques are reviewed. Procedures that can be employed for establishing the purity of radiolabeled lipid compounds are also discussed. Procedures for determining purity which are considered are thin-layer chromatography, glass fiber-paper chromatography, paper chromatography, and gas-liquid chromatography. Synthesis and exchange labeling of the following lipids are reviewed: ^{14}C- and ^{3}H-labeled saturated fatty acids, ^{14}C- and ^{3}H-labeled unsaturated fatty acids, ^{14}C-labeled monoglycerides and diglycerides, ^{3}H-labeled diglycerides, ^{14}C-labeled triglycerides, ^{3}H-, ^{131}I-, and ^{38}Cl-labeled glycerides, other ^{14}C-fatty acid esters not containing glycerol, ^{3}H-labeled fatty acid esters not containing glycerol, ^{14}C-labeled long-chain alcohols, ^{14}C- and ^{3}H-labeled glyceryl ethers, ^{14}C-labeled glycerol, ^{14}C- and ^{3}H-labeled cholesterol, ^{14}C-, ^{3}H-, and ^{131}I-labeled cholesteryl esters. (BBB) (TSS)

50915 RADIOISOTOPE METHOD FOR DETECTING TELLURITE UPTAKE BY STAPHYLOCOCCAL CELLS. Elliott, L. P.; Cashwell, R. J. (Western Kentucky Univ., Bowling Green). J. Gen. Appl. Microbiol. (Tokyo), 13: 359-63(1967).

A neutron activation analytical technique was used to determine the Te content of bacterial cells. The cells and tellurite were incubated together for 1 hr. Then the samples were centrifuged, washed, and resuspended in 3 ml of water, and irradiated for 20 min in a nuclear reactor. Total thermal neutron exposure for each sample was 1.2×10^{13} neutrons/cm^2. The resulting activity was counted with a NaI(Tl) well scintillation crystal and a 512 channel analyzer. The area under the 0.15 MeV ^{131}Te γ-ray peak was used to indicate the relative amount of Te in each sample. Reactor power level was held to 2% during each run by the automatic control channel. Results in staphylococcal cells showed that tellurite uptake took place primarily in the cytoplasm of the cell. Staphylococcal tellurite uptake, as determined by activation analysis, varied in different strains but could not be used as a means to differentiate species. Staphylococcal uptake could not be directly correlated with their ability to grow on tellurite-glycine agar and produce observed differences in blackness of colonies. In addition to being highly sensitive, the activation analysis method had an added advantage in that the handling of radioactive material was kept at a minimum. All the microbiological experiments were carried out with untagged tellurite and the cells were later irradiated; thus radioactive contamination was minimal. (BBB)

50916 DETERMINATION OF RHENIUM: CHLORINE RATIOS IN COMPLEXES BY NEUTRON ACTIVATION. Courrier, W. D.; Guest, A.; Lock, C. J. L.; Tomlinson, R. H. (MacMaster Univ., Hamilton, Ont.). Can. J. Chem., 46: 2965-7(Sept. 15, 1968).

A neutron activation method is described for the simultaneous determination of rhenium and chlorine in complex compounds. By determining atom ratios, it is unnecessary to weigh samples. The advantages of this method when applied to air-unstable compounds are described. (auth) (UK)

50917 POLAROGRAPHIC DETERMINATION OF CAESIUM IN THE PRESENCE OF OTHER ALKALI METALS BASED ON INTERACTION WITH THE CINNAMALDEHYDE RADICAL ANION. Barnes, D.; Zuman, P. (Univ. of Birmingham, Eng.). Analyst, 93: 589-94(Sept. 1968).

In this determination of caesium the wave i_M, corresponding to the reduction of a species formed by interaction of a cinnamaldehyde radical anion with alkali metal ions, is measured. This wave appears in 0.1 M lithium hydroxide solutions between the first two one-electron reduction steps of cinnamaldehyde. The height of this wave i_M increases with increasing alkali metal concentration, and is most sensitive to caesium, which can be determined in the range 0.003 to 0.1 M, in the presence of less than 0.03 M rubidium, 0.05 M potassium, and 0.1 M sodium, to within an accuracy of 5 per cent. The only observed interference was from short-chain tetraalkyl ammonium cations. (auth) (UK)

50918 FORMATION OF CHELATES OF NIOBIUM AND TANTALUM WITH ALIZARIN RED S. Agarwala, Badri Vishal; Dey, Arun K. (Univ. of Allahabad, India). Chim. Anal. (Paris), 50: 233-6(May 1968). (In French).

The composition, stability, and spectral characteristics of complexes of Nb(V) and Ta(V) with Alizarin Red S were determined; the chelate was red, with an absorption maximum at 470 nm for Nb at pH 4.0 and at 460 nm for Ta at pH 5.0. The composition was determined by Job's method of continuous variations, the mole ratio method, and Dey's method; in both cases it was 1 metal : 2 chelon. Data from these studies were also used to determine the equilibrium constants for formation; for Nb the value of the log formation constant was 8.33 ± 0.3, and for Ta 8.27 ± 0.3. The Nb

chelate was stable between pH 3.5 and 5.5; the Ta chelate, between pH 4.5 and 5.5. Only one compound is formed under conditions used (concentration range around 10^{-4}M; pH from 0.5 to 3.0). The ion produced was anionic and the phenolic O atoms are suggested as the atoms bonding to the metal. Analytical use of these chelates will require correction for moderate absorption of the chelon itself at the wavelength of maximum absorption of the complex. (BBB)

50919 ELUTION AND ANALYSIS OF RESIDUAL CHLORIDE FROM ANION EXCHANGERS. Pauwels, J.; Lauer, K. F. (EURATOM, Geel, Belg.). Z. Anal. Chem., 240: 225-8(1968).

Strong anion exchangers can be transformed to the hydroxyl forms by elution with analytical grade sodium hydroxide. The residual chloride contents remain above the 0.1% level. Such chloride amounts can rapidly and easily be determined with a radiochemical method using ^{110m}Ag as tracer. This method was compared with neutron activation and potentiometric titration methods. (auth)

50920 PHASE ANALYSIS OF THE COMPOUNDS OF THE SYSTEM $CaO-ZrO_2-SiO_2$. Belyavskaya, V. V.; Kupriyanova, L. A. Zavod. Lab., 34: 913-16(1968). (In Russian).

Phase quantitative analysis of the compounds in the system $CaO-ZrO_2-SiO_2$ was carried out in samples of alcohol–glycerate mixture, hot water, 2% HCl, HCl (1:1), HF, and H_2SO_4–HF mixture. Formulas for calculating the content in the mixture of each compound are given. (tr-auth)

50921 NEUTRON ACTIVATION DETERMINATION OF COPPER IN ENRICHED PRODUCTS BY THE METHOD OF $\gamma-\gamma$ COINCIDENCE. Gambaryan, R. G.; Danil'chenko, I. A.; Shtal, A. S. Zavod. Lab., 34: 975-8(1968). (In Russian).

A method for the activation determination of the copper content in enriched copper products by measurement of the $\gamma-\gamma$ coincidence using an isotopic neutron source is described. The copper equivalents of the positron emission are calculated. Samples of matte, concentrate, and other products with copper content from 14 to 41% were analyzed with a mean relative error of 5%. (tr-auth)

50922 NEUTRON ACTIVATION DETERMINATION OF TANTALUM IN ROCK AND MINERALS WITH SEPARATION OF INTERFERRING ELEMENTS BY CATION EXCHANGE. Shiryaeva, M. B.; Salmin, Yu. P.; Sergeeva, T. V. Zavod. Lab., 34: 923-5(1968). (In Russian).

A method for the mass neutron activation analysis of mineral raw materials for tantalum was developed. Interfering elements are separated on the cationite KU-2. The sensitivity of the method is 4×10^{-5}% Ta_2O_5. (tr-auth)

50923 SEPARATION OF ALUMINUM AND LANTHANUM. Uvarova, K. A.; Pikh, M. S.; Sikora, K. P. Tr. Vses. Nauch.-Issled. Inst. Khim. Reaktivov, No. 29, 136-41(1966). (In Russian).

The most suitable method for the complete separation of La and Al without interference in the complexometric determination of Al is to precipitate the $La(OH)_3$ with freshly prepared NaOH solution and this is the basis of the method for the analysis of lanthanum aluminate. A 0.3g sample is dissolved in 20 ml of concentrated HCl; any insoluble residue is fused with $K_2S_2O_7$. The melt is extracted with HCl and this is added to the main HCl solution. The total HCl solution is diluted to 100 ml. The La is precipitated from 20 ml of this HCl solution by boiling with 10% NaOH solution. The precipitate is washed with hot 2% NaOH (X10 to 15), and the precipitate is dissolved in 30 ml of H_2O acidified to pH 1 with HCl. To this solution, 2 ml of a 1% ascorbic acid solution, 30 to 50 ml of a buffer (27g Na acetate hydrate and 1 ml of anhydrous acetic acid in 1 l), and 2 ml of 0.05% xylenol orange are added; and the solution is titrated with 0.25M EDTA to produce a yellow color. After separating the La, the filtrate is neutralized with HCl to phenolphthalein, 30 to 40 ml of a buffer (150g of ammonium acetate and 1 ml of HCl in 1 l), 20 ml of 0.025M EDTA, and 2 ml of 0.05% xylenol orange are added; and the unconsumed EDTA is titrated with 0.02M $ZnSO_4$ to produce a red color. (Anal. Abstr.)

50924 RAPID SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM AND TIN IN URANIUM ALLOYS. APPLICATION TO U–Mo–Al–Sn ALLOYS. Ferlin, Claude; Lelievre, Bernard (Centre de Recherches, Romans-sur-Isere, France). Bull. Soc. Chim. Fr., No. 8, 3415-21(Aug. 1968). (In French).

Aluminum and tin, at concentrations higher than, or equal to, 200×10^{-6}, are rapidly determined in uranium alloys by formation, and spectrophotometric analysis, of aluminum Chrome Azurol S and tin pyrocatechol green gelatin complexes. The use of masking agents avoids interferences created by uranium and molybdenum. The determination of aluminum is carried out at pH 5.6. The molal extinction coefficient ϵ of the complex formed is equal to 5.9×10^4 at the wavelength λ = 548 nm. Among the elements studied, only beryllium interferes. The determination of tin was carried out at pH 2.3, in the presence of gelatin. ϵ = 5.9, 10^4 at 640 nm. Fe, from 15 μg in the test sample, Ti and Nb interfere. (auth)

50925 DETERMINATION OF ^{235}U IN ZIRCALLOYS BY NEUTRON ACTIVATION. Ceard, Pierre (Centre de Recherches Radiogeologiques, Nancy); Rouchaud, Jean-Claude; Deschamps, Norbert. Bull. Soc. Chim. Fr., No. 8, 3449-51(Aug. 1968). (In French).

The determination of ^{235}U in Zircaloys is made by determining one of its fission products. It is necessary to choose a fission product for which the chemical separation is easy, selective, and rapid. Among the numerous fission products of ^{235}U, ^{132}Te, with a period of 53 nm which gives ^{132}I with a period of 21 hr, was therefore chosen. After dissolving the sample in hydrofluoric acid, iodine is liberated by the oxidizing action of nitric acid. Iodine is distilled out in the elementary state and absorbed in soda. The standard is treated in a similar way. Measurements are carried out by γ spectrometry. The iodine-132 liberated has a specific activity such that a 20 mn irradiation at a flux of 3.10^{12} n/cm^2/s, permits the determination of uranium with a sensitivity reaching 5.10^{-3} ppM. (auth)

50926 APPLICATION OF ION EXCHANGE RESINS TO THE SYSTEMATIC ANALYSIS OF IMPURITIES IN MOLYBDENUM BY RADIOACTIVATION. Fedoroff, Michel (CECM–CNRS, Vitry-Seine, France). Bull. Soc. Chim. Fr., No. 8, 3451-3(Aug. 1968). (In French).

Irradiation of molybdenum by thermal neutrons, permitting a sufficiently sensitive determination of its impurities, leads to a high activity of the matrix. The behavior of molybdenum, technetium in a radioactive filiation, and of various elements on cationic and anionic resins, was investigated in media containing notably nitric acid, hydrochloric acid, and hydrogen peroxide. The separation of impurities is possible, behind a protective shield, by carrying out two successive operations on resins. (auth)

50927 CATALYTIC ANALYSIS OF MOLYBDENUM(VI) BY MEANS OF POLAROGRAPHIC METHOD. Kambara, Tomihito; Tanaka, Shigeyuki; Fukada, Kenjiro (Hokkaido Univ., Sapporo). Bunseki Kagaku, 17: 1144-6(Sept. 1968). (In Japanese).

The oxidation of iodide ion to iodine by hydrogen peroxide is catalyzed by Mo(VI). The dc polarographic wave height of iodide in the solution, which is 4.78 mM in hydrogen peroxide, 0.4 mM in potassium iodide, 1M in sulfuric acid, and 0.06% in gelatin, is traced at the potential of +0.2 V vs. mercury pool cathode. The logarithm of the iodide diffusion current i_d is plotted against time, resulting in a straight line, the slope of which shows a linear relationship with the amount of Mo(VI) in the electrolysis solution. By means of the present chronoamperometric method, the Mo(VI) in a microgram amount can be determined. (auth)

50928 DETERMINATION OF LANTHANUM IN RARE EARTH OXIDE MIXTURES BY X-RAY FLUORESCENCE. Funasaka, Wataru; Ando, Teiichi; Tomida, Yoshiro (Kyoto Univ.). Bunseki Kagaku, 17: 1133-6(Sept. 1968). (In Japanese).

Lanthanum in rare earth oxide mixtures was determined by three x-ray fluorescence methods: addition method, direct comparison method, and internal standard method. By the last method with barium as internal standard, lanthanum and cerium could be determined simultaneously with no influence of co-existing thorium. The results obtained by the three methods were in good agreement. The validity of the lanthanum contents thus determined was supported by the results of lanthanum oxide addition experiments and of chemical analysis of cerium, as well as by the consideration on the "infinitely diluted state." (auth)

50929 DETERMINATION OF CERIUM IN YTTRIUM OXIDE WITH A PAIR OF GLASSY CARBON ELECTRODES. Nakashima, Ryozo; Furukawa, Masamichi; Sasaki, Shozo; Shibata, Shozo (Government Industrial Research Inst., Nagoya, Japan). Bunseki Kagaku, 17: 1066-71(Sept. 1968). (In Japanese).

The differential polarographic titration of cerium with hydroquinone standard solution was studied, and the method was applied to the determination of cerium in yttrium oxide. The strengths of 0.01N and 0.001N hydroquinone solutions containing 0.005 M H_2SO_4 were unchanged at least for 30 days. The conditions for obtaining the most favorable titration curves using a pair of glassy carbon electrodes (area 0.07 cm^2) were: constant current 0.5 to 1.0 μA, and titration speed near the end point 0.2 ml/min. Under these conditions, 10 mg ~ 20 μg of cerium was determined in a wide range of concentration of H_2SO_4 or HNO_3 with good reproducibility. One tenth amount of permanganate did not interfere, but beyond this value, the titrant consumed was decreased. In the presence of chromate or vanadate, two inflection points were obtained on the titration curves. Simul-

taneous determination of cerium and chromate or vanadate by these curves gave insufficient results. Less than $1/10$ amount of chromate or $1/2$ amount of vanadate was only permissible for precise determination of cerium. Tungsten(VI), Mo(VI), Fe(III), Ti(IV), Th(IV), and Pb(II) by the same amount did not interfere. Several methods for oxidation were compared on the influence of oxidizing agents, among which the oxidation with PbO_2 in 2 to 3M HNO_3 was most suitable. (auth)

50930 INORGANIC POLAROGRAPHY IN ORGANIC SOLVENTS. IV. POLAROGRAPHY OF METAL OXINATE COMPLEXES IN VARIOUS SOLVENTS. Dagnall, R. M.; Hasanuddin, S. K. (Imperial Coll. of Science and Tech., London). Talanta, 15: 1025-9(Oct. 1968).

The polarography of 24 metal oxinate complexes, including uranium, extracted into chloroform, IBMK, and ethyl acetate was investigated, a methanolic solution of lithium chloride being used as base electrolyte. Only 15 complexes gave rise to reduction waves, and interference-free determinations were developed for indium and thallium(III) in chloroform, and for bismuth, molybdenum, and uranium in IBMK. The use of ethyl acetate offered no special advantages, and was the least selective of the three solvents used. (auth)

50931 DETERMINATION OF HAFNIUM IN ZIRCONIUM BY RADIOCHEMICAL METHODS. I. Shamaev, V. I. Radiokhimiya, 10: 475-9(1968). (In Russian).

An extraction method and radiochemical analysis were developed for determination of Hf and Zr in the presence of each other. The method, based on the partial separation of both elements, makes it possible to carry out their separate determination, if the concentration of one of them does not exceed 7 to 10%. The method of radiometric correction with use of the four-stage extraction makes it possible to determine Hf if its content in Zr is of the order of 1%. The use of the extracting system with very high partition coefficient of both elements expands the above determination limits. (tr-auth)

50932 QUESTION OF THE SEPARATION OF MACROQUANTITIES DURING ANALYSIS OF GERMANIUM OF A SPECIFIC PURITY BY THE NEUTRON-ACTIVATION METHOD. Shuba, I. D.; Razumova, G. N.; Vasil'ev, I. Ya. Radiokhimiya, 10: 501-3 (1968). (In Russian).

A method was proposed for precipitation of Ge in the form of germanium dioxide hydrate, creating the possibility of separation from microadmixtures and volatile components such as mercury. It was established that microquantities of Cu, Zn, Cd, Hg, Sb, As, and Au are practically unadsorbed and are not coprecipitated with germanium. The sorption percent of the admixture does not exceed 5%. (tr-auth)

50933 NEUTRON-ACTIVATION DETERMINATION OF TANTALUM IN NIOBIUM AND OF NIOBIUM IN TANTALUM. Gil'bert, E. N.; Pronin, V. A.; Torgov, V. G. Radiokhimiya, 10: 500-1(1968). (In Russian).

A method for the fast neutron-activation determination of Ta in Nb and of Nb in Ta was developed. Separation was accomplished by the extraction method using α-n-nonylpyridine-N-oxide as an extractant. (tr-auth)

50934 PRECISE GEOMETRY-INDEPENDENT RADIOASSAY OF LARGE BIOLOGICAL SAMPLES. Gibbs, William D.; Hodges, Harold D.; Lushbaugh, C. C. (Oak Ridge Associated Univ., Tenn.). J. Nucl. Med., 9: 264-6(June 1968).

An instrument, consisting of two opposed head scintillation detectors and photomultipliers connected to a pulse-height spectrometer, and a counting method for accurate radioassay of large, intact, biological samples are described. Within wide geometric limits the instrument and counting method requires neither a standard sample shape, standard volume, nor uniformity of radioisotope distribution within the sample. Accuracy of the radioassays is limited primarily by counting statistics even when samples are large as 500 g with a dimension of 15 cm or less are used. (auth)

50935 THE Rb–Sr ANALYSIS OF SOME SULFIDE MINERALIZATION. Reesman, R. H. (Massachusetts Inst. of Tech., Cambridge). Earth Planet. Sci. Lett., 5: 23-6(Sept. 1968).

The analyses of sulfide ores by isotope dilution mass spectrometry revealed that they contain low concentrations of Rb and Sr. The Rb/Sr ratios appeared to be adequate for dating these ores. (auth)

50936 ESTIMATION OF STRONTIUM IN BIOLOGICAL MEDIA BY ATOMIC ABSORPTION. Descube, J.; Roques, N.; Rousselet, F.; Girard, M.-L. (Faculte de Pharmacie, Paris). Ann. Biol. Clin. (Paris), 25: 1011-24(1967). (In French).

Estimation of Sr in biological materials, an important assay procedure either when radiostrontium from fallout sources is to be determined or Sr as a tracer for Ca metabolism, may be difficult because of the problem of separating the relatively small amount of Sr from the more plentiful Ca. However, the necessity of such separation can be avoided by use of emission flame photometry after preliminary precipitation of alkaline earth ions as the oxalate salts. Thus the estimation of Sr used as a Ca tracer in the metabolic study of Ca and P can be made easier by spectrophotometry with atomic absorption. The sensitivity of the technique allows the measurement of physiological levels of Sr in the blood, that were not detectable previously. The instrumental and chemical interactions, once delineated, can be corrected by the use of an appropriate spectral buffer. By the method described here it was possible to estimate 0.1 mg/l of Sr in various biological media with a reproducibility greater than 5%. (BBB)

50937 DIRECT METHOD FOR SPECTROCHEMICAL DETERMINATION [D.C. ARC] OF 39 IMPURITIES IN URANIUM MATRIX. Avni, R. (Nuclear Research Centre, Negev, Israel). Spectrochim. Acta, Part B, 23: 619-34(Sept. 1968).

A new method used for the spectrochemical determination of 39 impurities in uranium is described. This direct method uses only uranium in U_3O_8 form without addition of "carrier" or chemical treatment. The line spectra of the impurity elements are taken only in the cathode region instead of the whole dc arc. This region proved to be very convenient because, while being poor in atomic and ionic lines of the uranium matrix, it is very rich in atomic and ionic lines of the impurities. The method is quick, and its accuracy (±12%) and detection limits of impurities are as good as other spectrochemical techniques in use. The arc plasma parameters such as temperature, voltage, electric field, free electrons density, and total particle concentration of the matrix element were studied in order to explain the behaviour of the cathode region of the dc arc. (auth) (UK)

50938 ANALYSIS OF MILD STEEL BY X-RAY FLUORESCENCE. Visapaeae, A. (State Inst. for Tech. Research, Helsinki). Kem. Teollisuus, 24: 401-10(1967).

The determination of Ti, V, Cr, Mn, Co, Ni, Cu, As, Mo, Sn, Sb, W, and Pb was studied, with use of 11 standardised samples. The relationship between the concentration of the element and the ratio (to a selected standard) of the net line intensities (line minus background) or of the signals is rectilinear for all but Sn and W; the coefficients of the regression equations are given. The correlation is poor for Sn, owing to high background values; for W, a quadratic equation is proposed. The coefficient of variation is ≈0.4%. Limits of detection in a 100-sec count are ≈0.0005%. (Anal. Abstr.)

50939 TRACE ELEMENT PARTITION BETWEEN TWO PYROXENES AND THE HOST LAVA. Onuma, Naoki (Tokyo Univ.); Higuchi, Hideo; Wakita, Hiroshi; Nagasawa, Hiroshi. Earth Planet. Sci. Lett., 5: 47-51(Sept. 1968).

Partition coefficients for +1, +2, +3, and +4 valent trace ions between alkaline olivine basalt lava and the coexisting ortho- and clinopyroxene phenocrysts from Takashima, North Kyushu, Japan, were determined by neutron activation analysis. Substitution of trace elements in crystal lattice sites is proposed for the mechanism of trace element partition by examining the relation between measured partition coefficients and ionic radius and ionic charge. (auth)

50940 RECENT TRITIUM CONTENT IN NATURAL WATERS. Vinogradov, A. P.; Devirts, A. L.; Dobkina, E. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 10, 1147-62(Oct. 1968). (In Russian).

A method for determining tritium in natural objects without isotopic enrichment is described. The β-activity of tritium was measured in a proportional counter; acethylene or ethane were the counting gases. Data are given on tritium content in atmospheric precipitates and moisture in the Moscow region, in rivers and lakes of the European part of the USSR, and in surface water of the ocean. In 1967 the average content of this isotope in atmospheric precipitates in Moscow was 183 T.E. (tritium equivalent). (auth)

50941 RADIOCHEMICAL STUDIES ON SOME MICRO-COMPONENTS OF MINERAL SPRING WATER AND SINTER DEPOSIT IN ISHIKAWA PREFECTURE. Itakura, Tadashi (Public Health Lab. of Ishikawa, Japan). Onsen Kogakkaishi, 5: No. 2, 41-7 (Mar. 1968).

Uranium isotopes in mineral spring water were collected on a Dowex A-1 chelate resin column. Uranium isotopes eluted from this column were electrodeposited on the stainless plate from an electrolytic solution containing ammonium formate. From the alpha spectrum of this counting plate, U content and $^{234}U/^{238}U$ ratio in the sample could be found. Activation analysis of As was studied to establish a simple and sensitive determination of this element in mineral spring water. A sample solution of 1 ml or 10 ml was irradiated with neutrons for about 22 hr. The neutron flux was about 5×10^{11} n/cm^2/sec and standard samples containing known amounts of As were irradiated together with the mineral spring

samples. After irradiation, radioactive ^{76}As was separated from the sample using the Gutzeit method. It was confirmed by α spectrometry that this simple method was very effective to obtain radiochemically pure ^{76}As and determination of As in the sample can be made by counting the radioactivity of this nuclide. (NSA of Japan)

50942 DETERMINATION OF NATURAL URANIUM ISOTOPIC COMPOSITION BY X-RAY FLUORESCENCE AND RADIOMETRIC ANALYSIS. Lenin, S. S.; Serikov, I. V. At. Energ. (USSR), 25: 57(July 1968). (In Russian).

A variation to the I. E. Starik et al. (Geokhimiya No. 5, 1958) α-weight method is suggested for isotopic ratio analysis. The isotopic ratio of $^{234}U/^{238}U$ in electrolytically coated foils of U on Al disks can be determined by measuring their fluorescence, corresponding ^{238}U, and the total α activity. However, when the U layer is so thin ($\gg 100 \mu g/cm^2$) that α and x absorption is negligible, then the ratios $N_p = kU$, and $N_\alpha = l(U_I + U_{II})$ can be used (N_p is the number of recorded uranium fluorescence emission quanta, N_α is the number of recorded α particles, U_I is the ^{238}U content in the layer, and U_{II} is the ^{234}U content in the layer in equilibrate ^{238}U units, k and l are coefficients of proportionality. Tabulated data are given for results of suggested U_{II}/U_I ratio method and α spectrometric method. (R.V.J.)

50943 BETA-FLUORESCENT ANALYSIS OF BINARY MIXTURES OF PURE METALS. Kryukov, S. N.; Karamanova, Zh. S. Vestn. Mosk. Univ., Ser. II. Khim., No. 4, 9-11(July-Aug. 1968). (In Russian).

The radiation spectra excited by β particles of ^{204}Tl, ^{147}Pm, and ^{14}C in binary mixtures of pure metals (Ni–Mo, Mo–W) were studied for reflection geometry. Dependence of K-line intensity on the mixture composition was investigated. (auth)

50944 DETERMINATION OF FLUORINE IN SEAWATER BY PHOTON ACTIVATION ANALYSIS. Wilkniss, P. K.; Linnenbom, V. J. (Naval Research Lab., Washington, D. C.). Limnol. Oceanogr., 13: 530-3(July 1968).

A photon activation analysis method was developed for total fluorine in seawater free from complexing interferences, which would provide an independent check on values previously reported. All irradiations were carried out at electron beam energies of 22 MeV, a level high enough to bring about the $^{19}F(\gamma,n)^{18}F$ reaction, but too low to induce interfering reactions. The limit of detection for F was calculated to be 7×10^{-9} g of F, or approximately 0.002 ppM when a 5-g sample of seawater was used. Although the activation results did not match the reproducibility of previously reported spectrophotometric methods, the method has potential for simultaneous determination of F, Br, and I in samples of interest to marine geochemistry. (P.C.H.)

50945 DETERMINATION OF MOLYBDENUM IN SEAWATER. Kim, Young Sik; Zeitlin, Harry (Univ. of Hawaii, Honolulu). Limnol. Oceanogr., 13: 534-7(July 1968).

A method has been developed for the determination of Mo in seawater that is based upon complexing Mo with oxine (8-hydroxyquinoline), coprecipitation with aluminum sulfate and tannic acid at a pH of 4.0, and spectrophotometry. The overall procedure is sensitive, accurate, reproducible, somewhat less tedious, and can be used routinely with a sample size of 500 ml of seawater. In assessing the effectiveness of the determination in terms of recovery of Mo from seawater, it was assumed that the Mo content was the sum of the amount added and that found in the control. The results showed that the recoveries range from 98.0 to 101.3% with an average of 99.7%. The relative standard deviation based on the average recovery of 99.7% was 1.37%. (P.C.H.)

50946 1-(2-PYRIDYLAZO)-2-NAPHTHOL AS A POSSIBLE INDICATOR FOR THE CHELOMETRIC DETERMINATION OF SCANDIUM AND YTTRIUM. Tripathi, Satyendra N.; Agarwala, Badri V.; Dey, Arun K. (Univ. of Allahabad, India). Microchem. J., 13: 392-5(Sept. 1968).

The compound 1-(2-pyridylazo)-2-naphthol (PAN) has been proposed as an indicator for the complexometric determination of scandium and yttrium, the titration being done against EDTA. The suitable pH values at which the determinations are possible are 4.5 (for scandium) and 6.3 (for yttrium). The concentration of the indicator and temperature have no appreciable effect on the titer values. It was found that titration can be carried out down to concentrations of 2.5×10^{-4} M. The color change is from red to yellow and in both the cases, back titration is also possible. The determination of yttrium in the presence of scandium is also possible. Interferences by ions in the determinations have been noted. The cations and anions which do not interfere are: Na(I), K(I), Li(I), Sr(II), Ba(II), Hg(II), Be(II), Cr(VI), Ge(IV), Zr(IV), Ti(IV), As(III), Sb(III), Te(IV), Ir(III), Rh(III), Os(VIII), Cl^-, Br^-, I^-, NO_2^-, NO_3^-, SO_4^{2-}, SO_3^{2-}, PO_4^{3-}, WO_4^{2-}. (auth)

50947 URANIUM, THORIUM, AND POTASSIUM CONTENTS OF POSSIBLE MANTLE MATERIALS. Wakita, Hiroshi (Japan Atomic Energy Research Inst., Tokyo); Nagasawa, Hiroshi. Geochem. J. (Nagoya), 1: 183-98(Dec. 1967).

Neutron-activation determination of U, Th, and K was made on some possible mantle materials, mainly peridotite nodules from continental and oceanic areas. The analytical procedures for U and Th determination are described, and the results showed that oceanic nodules have more uniform concentrations of U, Th, and K and Th/U, K/U ratios than continental nodules. Average values for 7 oceanic herzolites are: $(1.87 \pm 0.27) \times 10^{-3}$ gU/g, $(5.48 \pm 0.87) \times 10^{-3}$ g Th/g, and $(54.2 \pm 7.5) \times 10^{-6}$ gK/g, giving a rate of heat production, 26×10^{-16} cal/cm^3·sec, which is about 70% of that for the average chondrite. There is no indication that oceanic herzolites are more enriched in these elements than the continental ones. These results suggest that, from the thermal point of view, peridotite nodules may not be the representative constituent of the upper mantle, unless the oceanic mantle is capable of transferring heat exceedingly well. The average values of the ratios are Th/U = 2.93 ± 0.61, and K/U = $(0.29 \pm 0.06) \times 10^4$. The latter is significantly smaller than the crustal value (1×10^4), which is already smaller than the chondritic value (5×10^4). (NSA of Japan)

50948 APPLICATION OF X-RAY RADIOMETRIC AND PHOTONEUTRON METHODS IN STUDYING ELEMENTARY COMPOSITION OF ROCKS AND ORES. Alekseev, V. V.; Ochkur, A. P.; Suvorov, A. D. pp 223-30 of Geologicheskie Rezul'taty Prikladnoi Geofiziki. Moscow, Izdatel'stvo Nauka, 1968. (In Russian).

The photoneutron method for quantitative determination of beryllium in samples, in the walls of mines and in boreholes is discussed. The sensitivity of this method when determining the beryllium content in samples is 1 to 3×10^{-4}%; analysis time is 2 to 3 minutes. When the beryllium content is determined in situ the sensitivity is 1 to 3×10^{-3}%. The x-ray radiometric method is used mainly for analysis of samples, and is being developed for studying elementary composition of rocks and ores in situ. The method is promising for determination of elements with atomic numbers of 20 to 25 and higher in the walls of mines and of 40 to 50 in boreholes. The results obtained show that it is possible in practice to determine the content of elements with absolute sensitivity of 0.2 to 0.5%. (auth)

50949 THE SIMULTANEOUS DETERMINATION OF MANGANESE AND COPPER IN BIOLOGICAL MATERIAL BY NEUTRON ACTIVATION ANALYSIS. Worwood, M.; Taylor, D. M. (Inst. of Cancer Research, Sutton, Eng.). Int. J. Appl. Radiat. Isotop., 19: 753-6(Oct. 1968).

After neutron activation and wet ashing, a manganese–copper fraction is prepared and the radioactivity due to ^{56}Mn and ^{64}Cu is determined by gamma spectroscopy. The limits of detection are 2×10^{-9} g for managanese and 2×10^{-8} g for copper. The method was used to analyze a standard kale powder, and the following concentrations of manganese and copper were found: Manganese 11.4 ± 0.28 μg/g; Copper 4.12 ± 0.04 μg/g dry powder. (auth) (UK)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 50918, 50920, 50927, 50993, 51107, 52257, and 52556.

50950 (ANL-Trans-660) CONTRIBUTION TO THE STUDY OF THE GASEOUS CARBURATION OF URANIUM. Esteban, J. Antonio; Jimenez, J. M.; De Villota, P. (Junta de Energia Nuclear, Madrid (Spain). Division de Metallurgia). Translated from report JEN-177-DMe/I-22. 31p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 30505.

50951 (RFP-Trans-47) KINETIC STUDY OF THE REDUCTION OF HEXAVALENT PLUTONIUM BY HYDROGEN PEROXIDE IN ACID SOLUTION. Lesigne, Bernard (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated from report CEA-R-3168. 39p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 16479.

50952 A KINETIKUS IZOTOP MODSZER ES ALKALMAZASAI. (Kinetic Isotope Method and Its Applications). Nejman, M. B.; Gal, Dezso. Budapest, Akademiai Kiado, 1967. 321p.

The kinetic isotope method was originally used in 1953–1954 at the Institute for Chemical Physics of the USSR Academy of Sci-

ences for studying complex reaction mechanisms in open systems. Since then the method has been widely applied at the Moscow State University and in England. It is an excellent tool for determining the rates of formation of intermediate processes and the consecutive order of certain elementary reaction steps. It may be used for gas-phase, liquid phase, heterogeneous catalytic, and solid state reactions. Up to now, mostly radioactive isotopes have been used, but use of stable isotopes, especially for solid-state reactions, appears promising. In such cases, different methods of measurement must be used, such as infrared spectroscopy, mass spectroscopy, or electron spin resonance. Application of the method for the study of parallel, consecutive, parallel-consecutive reactions, and heterogeneous catalysis is reviewed in detail. Biochemical applications include determination of the turnover rate and rate of transport process. (TTT)

50953 PROTON AND SODIUM TRANSPORT IN SiO_2 FILMS. Hofstein, Steven R. (RCA Labs., Princeton, N. J.). IEEE (Inst. Elec. Electron. Eng.) Trans. Electron Devices, ED-14: 749-59 (Nov. 1967).

An investigation was made of the relative roles of Na and H transport in SiO_2 films, using ^3H_2O, tritiated ethanol, neutron activation, and ^{22}Na to identify the mobile ions directly. Results of these analyses were then directly correlated with the observed electrical behavior. A layer of adsorbed water (^3H_2O) and ^{22}Na was introduced on the surface of the oxide to investigate the subsequent ion injection after metallization and BT (bias-temperature) stress. Sodium ion motion was tagged using neutron activation analysis, and proton motion was tagged using ^3H_2O with a level of 100 mCi/mM). The oxides tested included both steam grown and dry grown types [111] orientation 10 $\Omega \cdot$cm p-type chemically polished Si. Oxide thickness was 6000 Å. Samples were activated in a neutron flux of $10^{14}/cm^2 \cdot$sec for 90 hr and allowed to cool for several hours (to reduce the Si activity) before drifting. The possibility of proton drift was investigated using 3 types of tritiated ethanol, labeled on the α or β carbon or hydroxyl group. Details of the Na transport during recovery were investigated using vacuum deposited ^{22}Na contamination correlated with electrical measurements. The results showed that proton injection from oxide surface contamination plays a significant role in ion drift instability in MOS (metal oxide semiconductor) devices. Organic-contamination-induced instability, as typified by ethanol, consists primarily of the transport of protons and only secondarily of the migration of Na released from the oxide. Adsorbed Na-water contamination induced instability consists of both H and Na motion. It was confirmed that some Na can move in a fast mode strikingly similar to that for H motion. The slow or time symmetric component of the recovery is primarily due to Na motion dominated by trapping at the oxide-silicon interface. Both Na and H possess active and inactive forms in the oxide. Na can cause the release of a H from adsorbed surface water. An appendix provides details of tritium detection and counting techniques. (BBB)

50954 THIOUREA COMPLEXES OF RHENIUM AND TECHNETIUM. Morpurgo, L. (Univ., Rome). Inorg. Chim. Acta, 2: 169-72 (June 30, 1968).

Re(V)-thiourea complexes were prepared by gradual addition of thiourea (TU) to HCl solutions of NH_4ReO_4 and $SnCl_2$ in equimolar amounts. A blue complex absorbing around 600 mμ was initially formed, and after increasing the concentration of TU the maximum of the absorption band was shifted towards lower wavelengths and increased in intensity. The color of the solution turned pink-violet. From such solutions containing excess TU a greenish crystalline precipitate was obtained on standing that corresponded to the formula $ReO(TU)_4Cl_3 \cdot H_2O$. No precipitate could be separated from the blue solutions. The compound is diamagnetic; its reflectance spectrum is reported. By addition of 3 equivalents of $SnCl_2$ to a solution containing 1 mole of NH_4ReO_4 and excess TU, a yellow solution and a brown precipitate having a formula $Re(TU)_3Cl_3$ were produced. Orange solutions were produced by treating TcO_4^-, $TcOCl_5^{2-}$, or $TcCl_6^{2-}$ with TU in 2N HCl or HNO_3. Similarity of the chromatographic electrophoretic, and spectroscopic behavior of this compound with that of the yellow $Re(TU)_3Cl_3$ indicated that it is an analogous Tc(III) derivative. After mixing $TcOCl_5^{2-}$ and TU in 6N HCl a bright yellow color formed immediately. The spectrum of this solution shows an intense peak at 406 mμ and a much less intense one at 750 mμ. On standing the color faded and the spectrum became similar to that measured for $TcCl_6^{2-}$ in 6N HCl, with an absorption peak at 340 mμ and a shoulder at 308 mμ. It was concluded that more than 1 complex can be formed by Tc(V) with TU, depending on HCl concentration, in the same way as with Re(V) complexes, and that they probably do not contain a number of coordinated molecules as great as 4. (BBB)

50955 APPLICATIONS OF SLOW NEUTRON SCATTERING TO STUDIES IN COLLOID AND SURFACE CHEMISTRY. Boutin, H. (Picatinny Arsenal, Dover, N. J.); Prask, H.; Iyengar, R. D. Advan. Colloid Interface Sci., 2: 1-38 (Jan. 1968).

A review is given on neutron scattering processes, comparison of neutron scattering with other techniques, and survey of studies of neutron scattering from solid surfaces. Specific information not obtainable by other techniques can be extracted from the energy and momentum transfers of the neutrons interacting with colloidal systems through elastic and inelastic scattering processes. Neutron scattering techniques make it possible to study diffusive and rotational motions of hydrogenous groups, identification and characterization of bound as well as free water in the bulk and at the surface of many hydrates and precipitated oxides. A description of the interaction of the neutrons with an assembly of nuclei, limited to nuclear interactions, is given. A detailed discussion of results obtained from studies of water in its various phases and in well-characterized environments is included to show how neutron scattering can provide information on the thermodynamic parameters, vibrational energies (and therefore forces of interaction), and mobility of sorbed molecules which complements information derived from other techniques. Results of preliminary studies of water adsorbed on γ-alumina, silica, and rutile, hydrogen and methane adsorbed on charcoal, and a variety of adsorbates in zeolites along with conformational studies in polypeptides are presented. (BBB)

50956 APPARATUS FOR THE CONTINUOUS PRECIPITATION OF PLUTONIUM IN THE FORM OF OXALATE. Auchapt, Pierre; Bouzou, Georges (to Commissariat a l'Energie Atomique). U. S. Patent 3,395,988. Aug. 6, 1968. Priority date Sept. 19, 1963, France.

An apparatus for the continuous precipitation of Pu as the oxalate comprises a mixer having an inlet for oxalic acid, a conduit for admission of plutonium nitrate, a stirrer, and an overflow conduit for delivery of the precipitate to a settler. Both acid and water washing columns are connected to the settler, and the settler and each washing column have a recirculating conduit containing a sludge pump and a bypass conduit having valves and means for operating the valves in such a manner that the precipitate can be recirculated to the settler and the wash columns and from one successive device to another. (TSS)

50957 BEHAVIOR OF IODINE IN ADSORPTION AND DESORPTION BY GRAPHITE. Iwamoto, Kazumi (Japan Atomic Energy Research Inst., Tokyo); Oishi, Jun. J. Nucl. Sci. Technol. (Tokyo), 5: 437-46 (Sept. 1968).

Tracer studies were undertaken on the adsorption of iodine on natural graphite at temperatures ranging from 27° to 900°C under pressures from 0.03 to 1.4 mm Hg, and on the desorption of adsorbed iodine from the same specimens into either vacuum or Ar stream. The specimens were heated up either isothermally, stepwise, or at constant rate of temperature rise, up to 1,100°C. The resulting data accorded well with a theoretical treatment presuming desorption from a heterogeneous surface, considering the desorption as an n-th order irreversible reaction having distributed activation energies. The iodine is considered to be held on the graphite by physical adsorption below iodine and carbon atoms. The heat of adsorption and the activation energy of desorption obtained was found to be a function of surface coverage. The presence of Ar gas was observed to inhibit chemisorption of iodine and to decrease the activation energy of desorption of physically adsorbed iodine. (auth)

50958 CHEMISTRY OF PROTACTINIUM. I. AQUEOUS SOLUTIONS OF PENTA-AND TETRAVALENT PROTACTINIUM. Guillaumont, R.; Bouissieres, G.; Muxart, R. (Facultes des Sciences de Paris, Orsay, France). Actinides Rev., 1: 135-63 (June 1968). (In French).

A review is presented of the data available on the chemistry of aqueous solutions of penta- and tetravalent Pa. The behavior of these valence states in perchloric, nitric, hydrochloric, sulfuric, oxalic, and hydrofluoric acid media is discussed. Various complexes and mixed complexes are also considered. 109 references. (J.S.R.)

50959 PEROXY NIOBIUM(V) AND TANTALUM(V) COMPLEXES WITH 8-HYDROXYQUINOLINE. Djordjevic, C.; Vuletic, N. (Inst. Rudjer Boskovic, Zagreb). Chem. Ind. (London), No. 40, 1360 (Oct. 5, 1968).

The preparation of stable diperoxy-bis (8-quinolinolate) niobate(V) and tantalate(V) is described. These complexes are of interest in regard to peroxy and 8-hydroxyquinoline coordination, as well as in regard to the overall symmetry of the ligand sphere. They were prepared by reaction of potassium niobate or tantalate solution in H_2O_2 with an alcoholic solution of the oxine. Properties are described, with particular reference to infrared spectra and molecular structure. It is thought that these complexes comprise an unusual and interesting coordination around Nb and Ta. (UK)

50960 PREPARATION OF BERKELIUM TETRAFLUORIDE AND ITS LATTICE PARAMETERS. Asprey, L. B.; Keenan,

T. K. (Los Alamos Scientific Lab., N. Mex.). Inorg. Nucl. Chem. Lett., 4: 537-41(Sept. 1968).

The preparation of BkF_4 on the microgram scale from ^{249}Bk is reported. Problems concerned with purification of the ^{249}Bk are described, and in particular separation from Ce. For preparation of the BkF_4 the loaded (Bk) single ion exchange resin bead technique was employed, in conjunction with a fluorine-resistant sapphire crucible, at 400°C, and using a He atmosphere. Partial powder patterns for BkF_4 (and UF_4) are tabulated. The BkF_4 was found to be monoclinic, isostructural with UF_4, space group C2/c. Lattice parameters were: $a_0 = 12.47 \pm 0.06$, $b_0 = 10.58 \pm 0.04$, $c_0 = 8.17 \pm 0.05$ Å, $\beta = 125.9 \pm 0.2°$. The molecular volume was calculated as 72.8 Å^3. (UK)

50961 MECHANISM OF BASE-CATALYZED HYDROGEN EXCHANGE FOR N-METHYLPYRIDINIUM ION AND PYRIDINE N-OXIDE. RELATIVE POSITIONAL RATES. Zoltewicz, John A.; Kauffman, Glenn M.; Smith, Craig L. (Univ. of Florida, Gainesville). J. Amer. Chem. Soc., 90: 5939-40(Oct. 9, 1968).

Since the relative positional rates of base-catalyzed hydrogen exchange at the annular positions of N-methylpyridinium chloride (I) and pyridine-d_5-N-oxide (II) are very similar to the known relative rate of decarboxylation of the isomeric N-methylpyridinium carboxylates (III), these similar rate relationships provide considerable insight into the mechanism of the deprotonation reactions and the mode of activation by the heteroatom groupings. Kinetic data indicate that the reactivity pattern for the deprotonation of I and II not only is qualitatively the same as that for the decarboxylation of III but also that the relative reactivities of corresponding positions within the three molecules are quantitatively similar. Reactivity is greatest adjacent to the activating heteroatom and rapidly decreases with increasing distance from this center. (D.H.M.)

50962 DEUTERIUM ISOTOPE EFFECT IN TRIPLET ELECTRONIC ENERGY TRANSFER RATES. FROM BENZENE AND ACETONE TO OLEFINS. Schmidt, Manfred W.; Lee, Edward K. C. (Univ. of California, Irvine). J. Amer. Chem. Soc., 90: 5919-21(Oct. 9, 1968).

A study of the deuterium rate isotope effect observed in the triplet excitation energy transfer process in the gas phase is reported. The experimental measurements involved monitoring of either the competitive quenching of benzene-photosensitized cis–trans isomerization of 2-butenes by olefinic quenchers of the quenching of acetone phosphorescence emission at room temperature. Observation disclosed that the acceptor isotope effect on quenching rate constants (k_H of C_2H_4/k_D of C_2D_4) for the triplet C_6H_6 is 1.7 ± 0.2, while the corresponding ratio for the triplet CH_3COCH_3 was 1.9 ± 0.2. A somewhat lower deuterium rate isotope effect, however, was found with propylene as a quencher. (D.H.M.)

50963 MASS SPECTROMETRIC STUDIES OF PLUTONIUM COMPOUNDS AT HIGH TEMPERATURES. II. THE ENTHALPY OF SUBLIMATION OF PLUTONIUM(III) FLUORIDE AND THE DISSOCIATION ENERGY OF PLUTONIUM(I) FLUORIDE. Kent, R. A. (Los Alamos Scientific Lab., N. Mex.). J. Amer. Chem. Soc., 90: 5657-9(Oct. 9, 1968).

A mass spectrometric investigation of the sublimation of PuF_3 in the temperature range 1243 to 1475°K established the principal vapor species to be $PuF_3(g)$. The vapor pressure is given by the equation $\log P(atm) = [(-20{,}734 \pm 118)/T°K] + (9.288 \pm 0.087)$. The enthalpy and entropy of sublimation at 298°K are calculated to be 101 ± 3 kcal mole^{-1} and 51.6 ± 2.5 eu, respectively. Studies of the equilibria among gaseous species over the mixture Pu + PuF_3 yielded the atomization energies of $PuF_3(g)$ and $PuF_2(g)$ and the dissociation energy of PuF(g). (auth)

50964 HYDROFLUORINATION OF CURIUM DIOXIDE. Moseley, J. D.; Robinson, H. N. (Dow Chemical Co., Golden, Colo.). J. Inorg. Nucl. Chem., 30: 2277-9(Sept. 1968).

Temperature conditions necessary for a rapid, complete reaction between CmO_2 and HF were determined. The reaction was examined at 185, 310, and 435°C using thermogravimetric analysis techniques. At 185°C the conversion was approximately 21% complete at 6 min, 25% at 12 min, and 34% at 1 hr. At 310°C the reaction was 50% complete at 6 min, 63% at 12 min, and 84% at 1 hr. At 435°C the conversion was >98% at 6 min, >99% at 12 min, and >99.9% at 40 min. (M.C.G.)

50965 NEUTRON BEAM RESEARCH COMMITTEE, ANNUAL REPORT, 1967. [London], Science Research Council (UK), University Science and Technology Board, 1968. 103p.

Studies carried out by university users of neutron beam and irradiation facilities at AERE, Harwell, and AWRE, Aldermaston are reviewed under the following main headings: chemical crystallography; magnetic crystallography; inelastic excitation of solids; liquids; defects; properties of neutrons; radiation damage; activation analysis; miscellaneous irradiations. (UK)

50966 STABILITY OF LABELED ORGANIC COMPOUNDS. Bayly, R. J.; Catch, J. R. RCC Review No. 3. Amersham, Eng., Radiochemical Centre (UKAEA), 1968. 22p.

It is emphasized that this pamphlet is written for the user of radioactive tracer compounds, and not for radiation chemists. Headings are as follows: definitions; purity of labeled compounds; factors underlying self-decomposition; protective measures (general, against primary decomposition, against secondary decomposition, and against decomposition independent of radiation); storage precautions; some decomposition data. A tabulation of self-decomposition data is given for a variety of labeled organic compounds. (UK)

50967 CALCULATION OF VAPOR PRESSURE ISOTOPE EFFECTS IN CH_3OH/CH_3OD, CD_3OH/CD_3OD, HCl/DCl, HBr/DBr, AND H_2S/D_2S FROM SPECTROSCOPIC DATA. Wolfe, H.; Wolff, E.; Hoeppel, H.-E. (Univ., Heidelberg). Ber. Bunsenges. Phys. Chem., 72: 644-9(Aug. 1968). (In German).

Using a statistical thermodynamic relation, which permitted the approximate calculation of the vapor-pressure isotope effect for water and ice, the vapor pressure ratios of the pairs of compounds CH_3OH/CH_3OD and CD_3OH/CD_3OD in the liquid state and HCl/DCl, HBr/DBr and H_2S/D_2S in the solid state were calculated. Comparison with the measured values from the literature shows agreement within the limits of error of the pressure measurements or of the spectroscopic data used in the calculation. The results show that the observed vapor pressure isotope effect arises from the superposition of a normal effect of the intermolecular vibrations and an inverse effect of the intramolecular vibrations, and its sign, whether normal or inverse, depends upon which of the two effects predominates. (auth)

50968 CRYSTALLINE STRUCTURE OF THE DOUBLE OXIDE UNb_9O_{10}. Chevalier, Raymond; Gasperin, Madeleine (Faculte des Sciences, Paris). Compt. Rend., Ser. C, 267: 481-3(Aug. 5, 1968). (In French).

The locations of the metal atoms and of 80 oxygen atoms were determined by means of three-dimensional Fourier syntheses. Development of metal atomic weights and the calculation of interatomic distances permitted differentiation between the valences of Nb and showed the Nb +5 site to be vacant. This was interpreted as an increase in weight of Nb^{4+} which is progressively replaced by U^{6+} according to the formula $U^{6+}_{+x}Nb^{5+}_{-x}Nb^{5+}_{(10-2x/9)}O_{10}$ with $O \leq x \leq 1$. (tr-auth)

50969 IONIC CONDUCTIVITY OF OXIDE FILMS ON NIOBIUM. Egorov, V. V.; Lukovtsev, P. D. Elektrokhimiya, 3: 1071-5(Sept. 1967). (In Russian).

During oxidation in a 0.1N H_2SO_4 solution, the impedance of a Nb electrode was determined as a function of current density and the thickness of the oxide layer. The impedance of the electrode increased with an increase in oxide film thickness and decreased with an increase in current density. The specific conductivity of the oxide film on the metal was found to be proportional to the current density and decreased sharply when the polarizing current was disconnected. The presence of a steady field gradient, independent of thickness of oxide film, was indicated. The mechanism responsible for the field gradient is discussed. (TSS)

50970 DIFFERENCE IN THE ELECTRODE POTENTIALS OF THE AMALGAMS OF TWO LITHIUM ISOTOPES. Ageev, R. P.; Balashov, V. L.; Kiselev, B. P. Elektrokhimiya, 3: 1002-4(Aug. 1967). (In Russian).

Electrode potentials of the amalgams of ^6Li and ^7Li were compared by direct measurement of the potentials arising at the interface between the amalgams of ^6Li and ^7Li and aqueous solutions of ^6LiOH and ^7LiOH. A difference of ~2mV compared favorably with previously reported results. (TSS)

50971 POLYMORPHIC AND DEHYDRATION PHASE BOUNDARIES IN THE SYSTEMS $BaCl_2$–H_2O AND $BaCl_2$–D_2O TO 40 KILOBARS. Pistorius, Carl W. F. T. (South African Council for Scientific and Industrial Research, Pretoria). Z. Phys. Chem. (Frankfurt), 60: 114-25(July 1968).

The phase boundaries involving polymorphism and dehydration in the systems $BaCl_2$–H_2O and $BaCl_2$–D_2O were studied to 40 kilobars by means of differential thermal analysis. $BaCl_2 \cdot 2H_2O$ and $BaCl_2 \cdot H_2O$ both have new high-pressure forms. Above ~30 kilobars $BaCl_2 \cdot H_2O$ has no region of stability anymore, but converts to a mixture of $BaCl_2$ and $BaCl_2 \cdot 2H_2O$. The phase boundaries in the system $BaCl_2$–D_2O are located 2 to 8°C below the corresponding boundaries in the system $BaCl_2$–H_2O. The low-pressure invariant point representing the dehydration of $BaCl_2 \cdot D_2O$ is located at 265°C. (auth)

50972 ELECTRONIC BAND STRUCTURE AND OXYGEN POTENTIAL IN THE SYSTEM Zr–C–O. Miller, Alan Dale. Seattle, Univ. of Washington, 1967. 128p.

Thesis.

The electronic band structures of a series of compositions corresponding to substitutional oxygen solubility in the ZrC lattice were calculated using a modified tight-binding approach. The two-center integrals necessary for the calculation were estimated from values found for similar materials. The band structures indicate that compositions with up to 50 per cent oxygen substitution for carbon in the lattice remain metallic conductors. A calculation of the relative cohesive energy as a function of composition shows a minimum near 35 per cent oxygen substitution. This behavior supports the presence of a ternary compound in the system. An experimental study of the oxidation of ZrC by low oxygen potential atmospheres was conducted. The experiments were done in atmospheres with oxygen partial pressures between 10^{-6} atmospheres and 10^{-18} atmospheres at temperatures from 1100 to 1550°C. Two carbon monoxide pressures were used, one atmosphere and 0.033 atmospheres. The study did not give any information as to the existence of the compound Zr_2CO. The results do, however, indicate very low solubilities of carbon in ZrO_2 and oxygen in ZrC under these conditions. (Disser. Abstr.)

50973 CHEMISTRY OF UO_2^{2+} GROUP. I. MOLECULAR STRUCTURE OF DIOXO-DINITRATOBIS(TRIPHENYLARSINE-OXIDE) URANIUM(VI). Panattoni, C.; Graziani, R.; Croatto, U.; Zarli, B.; Bombieri, G. (Centro Strutturistica Chimica, Padua). Inorg. Chim. Acta, 2: 43-8(Mar. 31, 1968).

The crystal structure of the complex dioxo-dinitratobis(triphenylarsine oxide) uranium(VI) was determined in an investigation of some uranyl complexes with triphenylphosphine and triphenylarsine oxides as ligands. X-ray diffraction studies are described. The crystals are monoclinic with a = 11.09 ± 0.04, b = 19.28 ± 0.06, c = 10.88 ± 0.04 A, β = 128° 10′ ± 10′, Z = 2, space group $P2_1/c$. Intensities of 921 independent reflections were obtained photographically with CuK_α radiation. The structure was solved by 3-dimensional Fourier syntheses and refined by full-matrix least squares. The final R index was 8.6%. The U atom is octacoordinated with 2 bidentate nitrate ions and 2 oxygens from ligands coordinated in the plane perpendicular to the uranyl group. (BBB)

50974 PAPER CHROMATOGRAPHY OF THE ELEMENTS THORIUM TO CURIUM IN HCl AND HNO_3 MEDIA. I. PROCEDURES AND EXPERIMENTAL DATA. Clanet, Frank (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Bull. Soc. Chim. Fr., No. 8, 3484-91(Aug. 1968). (In French).

The field of application of paper chromatography in inorganic chemistry has been extended to elements 90 to 96 in hydrochloric and nitric acid solutions. By using as eluents, mixtures of equal parts of aqueous HCl or HNO_3 solutions with alcohols (methanol, ethanol, butanol), the R_f values of elements 90 to 96 have been determined. (auth)

50975 HEPTAVALENT STATE OF TRANSURANIUM ELEMENTS. PRODUCTION AND IDENTIFICATION OF NEPTUNIUM (VII) IN AQUEOUS SOLUTION AND SOLID FORM. Krot, N. N.; Mefod'eva, M. P.; Smirnova, T. V.; Gel'man, I. A. D. Radiokhimiya, 10: 412-18(1968). (In Russian).

It was established that during the passage of ozone through a suspension of Np in alkali, bright green solutions of Np(VII) were obtained. The heptavalent state of Np in ozonized alkaline solutions was confirmed by different methods. A compound of Np(VII) with the composition $Co(NH_3)_6 \cdot NpO_5 \cdot 3H_2O$ was separated in the solid state and analyzed. (tr-auth)

50976 SOME THERMODYNAMIC CALCULATIONS IN THE SYSTEM URANYL NITRATE–WATER–n-BUTYL ESTER OF DI-n-BUTYLPHOSPHINIC ACID. Yakovlev, I. I.; Dyadin, Yu. A. Radiokhimiya, 10: 465-7(1968). (In Russian).

A thermodynamic analysis was made of the system uranyl nitrate–water–butyl ester of dibutylphosphinic acid (BEDBP). The free energy for the formation of the dissolvate $UO_2(NO_3)_2 \cdot 2BEDBP$ was calculated. (tr-auth)

50977 MEASUREMENT OF THE PARTIAL MOLAR FREE ENERGY OF OXYGEN $g^M_{O_2}$ (O/U) IN THE OXIDES UO_{2+x} SHOWING SMALL VARIATIONS FROM STOICHIOMETRY. Thomas, Catherine; Gerdanian, Paul; Dode, Maurice (Laboratoire de Chimie Thermodynamique, Orsay, France). J. Chim. Phys., 65: 1349-58(July-Aug. 1968). (In French).

The partial molar free energy of oxygen in oxides UO_{2+x} were measured between 900 and 1150°C and for 2.0014 < O/U < 2.04. The use of mixtures $CO-CO_2$ in well known proportions and the extremely careful utilization of an Ugine–Eyraud thermobalance enables us to determine with a precision of $\pm 10^{-4}$ the composition of the oxides in equilibrium with an atmosphere of a known P_{O_2}. The values of $g^M_{O_2}$ (O/U) at 1100°C appear independent of the origin and of the texture of the oxide. The present impossibility of obtaining $h^M_{O_2}$ (O/U) drawn out by derivation from $g^M_{O_2}$ (O/U) in the field very close to the stoichiometric composition and of the necessity of measuring it directly by calorimetry was noted. (auth)

50978 NUCLEAR MAGNETIC RESONANCE STUDY OF THE OXALATES AND FORMATES OF THORIUM. Demarquay, Jean; Pham-Quang-Tho; Mentzen, Bernard; Claudel, Bernard (Institut de Recherches sur la Catalyse, Villeurbanne, France. Institut National des Sciences Appliquees, Villeurbanne, France). J. Chim. Phys., 65: 1380-5(July-Aug. 1968). (In French).

Water molecules in crystalline mono- and dihydrated oxalates of thorium are shown, by NMR spectroscopy, to exist in H_2O form. In hexahydrated oxalate, a part of these H_2O molecules are in interstitial form. All the protons in anhydrous formate of thorium are in similar positions. Because of the complexity of the recorded spectra, no conclusion can be deduced about the relative positions of H_2O protons in hydrated formates. (auth)

50979 AMMONIATES AND AMMONOLYSIS OF URANIUM TRICHLORIDE. Berthold, H. J.; Knecht, H. (Univ., Mainz). Z. Anorg. Allg. Chem., 3: 356; 151-62(1968). (In German).

Uranium trichloride reacts with NH_3 (l. or g.) under atmospheric pressure to form ammoniates, which after the removal of excess ammonia at room temperature contain 6.8 to 6.9 moles of NH_3. Reaction of liquid NH_3 under pressure at room temperature yields ammoniates with 7.0 to 7.4 moles of NH_3. Also, a slight ammonolysis in liquid ammonia occurs. Isothermal decomposition of the ammoniates in a stream of nitrogen at 45°C leads to $UCl_3 \cdot 3\,NH_3$, which at higher temperatures decomposes into $UCl_3 \cdot NH_3$ (stable up to about 300°C). X ray investigations and the reaction with gaseous carbon dioxide show that in the case of the higher ammoniates of UCl_3 co-ordinatively bound NH_3 can be distinguished from "structural ammonia." Above 350°C in a stream of ammonia, UCl_3 and its ammoniates undergo ammonolysis, forming amorphous amidochlorides (UNH_2Cl_2, $U(NH_2)_2Cl$)), crystalline uranium imidechloride U(NH)Cl and at 800°C a pure higher uranium nitride, UN_x ($x \approx 1.75$). (auth)

50980 PARAMAGNETIC RESONANCE STUDY OF SINGLE CRYSTALS OF UF_6Li, UF_6Na AND UF_6Cs. Drifford, M.; Rigny, P.; Plurien, P. (CEN de Saclay, Gif-sur Yvette, France). Phys. Lett., 27A: 620-1(Sept. 23, 1968).

The paramagnetic resonance absorption of single crystals of UF_6Li, UF_6Na, and UF_6Cs were investigated as a function of the orientation of the external magnetic field. This study shows the UF_6^- ions to be axially distorted in these compounds, the deformation axis being the trigonal axis in UF_6Li and UF_6Cs and the [111] axis in cubic UF_6Na. (auth)

50981 USE OF INERT RADIOACTIVE GASES FOR STUDY OF SOLIDS. Balek, V.; Zaborenko, K. B. Radiokhimiya, 10: 450-64(1968). (In Russian).

A bibliographic survey is given of the use of radioactive inert gases in the study of the properties of solids. (92 references.) (J.S.R.)

50982 LASER ACTION IN SELECTED COMPOUNDS CONTAINING C, N, AND H OR D. Stafsudd, O. M.; Haak, F. A.; Radisavljevic, K. (Univ. of California, Los Angeles). IEEE (Inst. Elec. Electron. Eng.) J. Quant. Electron., QE-3: 618-20 (Nov. 1967).

Laser action was found in electrical discharge containing C, N, and H or D in their elemental forms. The wavelengths of oscillation observed were the same as those associated in the literature as resulting from transitions within rotation and vibrational states of the CN radical. Different wavelengths were observed when D gas was substituted for H. No laser action was observed in the absence of H or D in the discharge, confirming that the active species is not the CN radical. Ethanol, methanol, diethyl ether, dipropyl ether, methane, and acetylene, sometimes with N_2 were also tried. New lines were observed at 193.8, 198.8, 281, and 291 μ. The laser-active species in CN laser systems is indicated to be of the form H_xCN where x > 1. This is indicated by a change for D compounds and by the fact that H or D must be present in the discharge, and because the laser transitions do not fit the known energy-level diagram for the HCN molecule. In the case of the HCN laser some species of the type H_xCN is suggested (x > 1) as being produced in the discharge. The system $CH_4 + N_2$ appears to make possible long-life discharge tubes with power output an order of magnitude higher than has been available until now. (BBB)

50983 REDUCTION OF SOME RARE EARTH ELEMENTS WITH DIFFERENT AMALGAMS OF ALKALI METALS. Shvedov, V. P.; Frolkov, A. Z. Radiokhimiya, 10: 482-5(1968). (In Russian).

In the reduction of rare earth metals with alkali metal amalgams, the presence of some alkali metal ions affects specific adsorption on the mercury surface. The reduction of Sm^{3+}, Eu^{3+}, Yb^{3+}, and La^{3+} proceeds by different mechanisms, which are connected with the presence of the first three of elements in the divalent state. The pH of the solution and the formation of complexes of the rare earths with anions present in the solution affects the reduction processes. (tr-auth)

50984 NOTE ON THE CHLORINATING DECOMPOSITION OF SUBSTANCES CONTAINING NIOBIUM. Kock, Heribert; Klemm, Wilhelm (Univ., Muenster, Ger.). Z. Anal. Chem., 241: 130-2(1968). (In German).

In an investigation on the decomposition of oxide minerals containing Ti, Nb, Fe, U, and Y mixtures of TiO_2, Nb_2O_5, Fe_2O_3, U_3O_8, and Y_2O_3 were heated in streaming Cl_2 containing $SOCl_2$. In order to avoid the formation of $NbOCl_3$, which greatly disturbs the distribution pattern of the chlorides, the reaction boat was covered with carbon powder. $TiCl_4$ was absorbed in sulfuric acid; $NbCl_5$, $FeCl_3$ and UCl_4 were condensed in the reaction tube and were separated by usual methods; YCl_3 remained in the reaction boat. (auth)

50985 POLAROGRAPHIC BEHAVIOUR OF TELLURIUM(IV). Deshmukh, G. S.; Sankara Rao, V. S. (Banaras Hindu Univ., India). Z. Anal. Chem., 240: 322-4(1968).

An ammonium chloride–ammonium nitrate solution was used as the base electrolyte in a polarographic study of tellurium(IV). The polarogram exhibited a single well-defined step with an $E_{-\frac{1}{2}}$ of −0.71 V vs. S.C.E. at pH 6.3. No maxima were observed in the rising part of the wave or on the plateau. The effects of various parameters, such as base electrolyte concentration and height of mercury column, on the nature and definition of the polarogram were also investigated. (J.G.B.)

50986 ISOTOPIC EFFECTS ON THE HIGH RESOLUTION N.M.R. SPECTRA. Govil, G. (Tata Inst. of Fundamental Research, Bombay). Bull. Nat. Inst. Sci. India, No. 30, 1-7(1965).

The effects of isotopic substitution on chemical shifts are discussed. The nature of such effects and the different theories for explaining them are presented. The use of such effects for chemical analysis is demonstrated. (auth)

50987 ISOTOPE EFFECTS IN AUTOXIDATIONS. EFFICIENCY OF RADICAL FORMATION FROM AZOBISISOBUTYRONITRILE-d_{12}, HYDROGEN ISOTOPE EFFECT. Rummel, Siegbert; Huebner, Heinrich; Krumbiegel, Peter (Institut fuer Stabile Isotope, Leipzig). Z. Chem., 10: 392-4(Oct, 1967). (In German).

The mean efficiency coefficients a = (number of radicals observed/number of radicals calculated) for the thermal decomposition of azobisisobutyronitrile and its wholly deuterated analog were found to be $a_H = 0.56 \pm 0.015$ and $a_D = 0.51 \pm 0.015$. These values suggest that the isotope effect in the diffusion rate have a considerable influence on the efficiency of radical formation. The 5 to 10% smaller efficiency coefficient for the deuterated compound can be taken as supporting evidence for the presence of diffusion-dependent radical recombination reactions in the thermal decomposition of azonitriles in solution and therefore supports the cage theory. Values for the coefficient are compared with those reported by Hammond. Kinetic analysis of the reaction is developed. (BBB)

50988 CATALYTIC DEUTERIUM EXCHANGE REACTIONS WITH ORGANICS. XLII. THE PICOLINES, LUTIDINES, THIOPHEN, AND FURAN ON UNSUPPORTED GROUP VIII TRANSITION METALS. Calf, G. E.; Garnett, J. L. (Univ. of New South Wales, Kensington, Australia). Aust. J. Chem., 21: 1221-31(May 1968).

Deuterium exchange in the presence of D_2O was studied in the picolines (methylpyridines), lutidines (dimethylpyridines), thiophene, and furan on a variety of Group VIII transition metals. Platinum is the most reactive general labeling catalyst for the picolines and lutidines, whereas Co catalyzes exchange exclusively in the position α to the N atom. The labeling pattern in the picolines and lutidines is similar to that of the alkylbenzenes in that (1) position ortho to a methyl group is severely deactivated and (2) positions flanked by 2 methyl groups are severely deactivated. Compensation effects are observed involving steric hindrance to adsorption from the alkyl groups and enhanced strength of adsorption from the N lone pair. The compensation effect in this charge-transfer adsorption slightly favors the N lone pair. Thiophen and furan generally do not exchange appreciably with pre-reduced Group VIII transition metal catalysts. Thiophen exchanges rapidly on self-activated Pt oxide whereas self-activated Ir oxide is the most useful for furan. With $NiCl_2$, furan exchanges exclusively in the α positions. A theory is proposed to account for the novel exchange in both thiophen and furan. (BBB)

50989 COPRECIPITATION OF TRACE AMOUNTS OF STRONTIUM WITH BARIUM CHROMATE. Benes, J.; Kyrs, M. (Inst. of Nuclear Research, Prague). Collect. Czech. Chem. Commun., 33: 2822-32(Sept. 1968).

The conditions for coprecipitating traces of strontium with barium chromate, namely the original ratio of components, temperature, velocity of precipitation, presence of ammonium acetate, and amount of precipitate were investigated. The maximum yield of coprecipitation (80%) at pH ~8.5 was attained by slowly adding the barium salt to a solution containing the strontium, the chromate, and ammonium acetate. The experimentally found dependence of coprecipitation yield on the amount of precipitate was compared with four relationships derived for limiting cases of non-equilibrium distributions. Hermann's relationship was found to be valid for a certain region of the precipitants' amount ratio in which the constant concentration of the substituted ion in solution is determined by a constant concentration of the oppositely charged ion that forms isomorphic salts with the micro- and macro-components. A verification of the relationship for coprecipitation previously derived was also carried out. The relationships found were then discussed from the point of view of the dependence of coprecipitation on precipitate charge during the experiment. (auth)

50990 ANODIC OXIDATION OF RARE EARTH–ALUMINUM COMPOUNDS. Meyer, A. (Forschungslaboratorium der Siemens A.G., Munich). J. Less-Common Metals, 16: 203-14(1968). (In German).

With a number of rare earth–aluminum alloys it was found that anodic oxidation provides a simple metallographic method for phase identification. The characteristic interference colors of the oxide layers, produced in an aqueous solution of boric acid/borax with defined voltages on several intermetallic rare earth–Al compounds, are tabulated. The results are readily reproducible provided the electrolyte is not contaminated, particularly by halogen ions. (auth)

50991 METHOD OF PREPARING URANIUM DIURANTE. De Hollander, William R. (to General Electric Co.). U. S. Patent 3,394,997. July 30, 1968. Filed Apr. 12, 1965.

Ammonium diuranate suitable for preparation of UO_2 for reactor fuels was prepared from UF_6 by hydrolyzing the UF_6, adding an aqueous NH_4OH solution having a molarity of up to 1.2 to the aqueous fluoride solution to precipitate the diuranate, and then drying the ammonium diuranate. A continuous process is described for the operation. (Offic. Gaz.)

Radiation and Nuclear Chemistry

Refer also to abstracts 50965, 51056, 51144, 51470, 51471, 51855, 52099, 52104, and 52119.

50992 (CEA-R-3520) STUDY OF VARIATIONS IN BOND ENERGY IN IRRADIATED MOLECULAR SYSTEMS. Naudet, Gilbert; Passe Suzanne (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr. 1968. 45p. (In French). Dep.

On the basis of experimental results selected from publications, the evolution of the bond energy of a molecular system under irradiation, leading to a more or less bound state, was studied. This variation of bond energy was then compared to the total bond energy of the initial system and to the energy absorbed in the system during the irradiation. This was done as a function of the nature of molecular system and the radiation spectrum and intensity. The working method is explained, and the results obtained are given. (auth)

50993 (IFA-IS-52) THE SEPARATION OF DEUTERIUM BY CONTINUOUS COLUMN USING THE H_2–H_2O ISOTOPIC EXCHANGE. Mercea, Victor (Academia R. P. R., Bucharest, Institutul de Fizica Atomica). 23p. (In French). Dep.

The isotopic exchange reaction between hydrogen and water was considered for the separation of deuterium. The principles of the method are outlined and the experimental results obtained from various studies are compiled to show the limitations of the method. An elementary process was considered combining the H_2–H_2O isotopic exchange reaction with distillation of the water in order to obtain continuous separation columns. The principle of the method is outlined, and the experimental verification of the theory was summarized. A separation scheme utilizing complete phase conversion was also studied. The experimental installation for the study of this method of isotopic separation was described. The use of a dual-temperature system for the separation of deuterium was also tested on a pilot installation. The experimental results confirmed the theoretical calculations and showed the possibility of

using the dual-temperature methods for deuterium production. The application of these method to heavy-water cooled reactors and to other problems of isotopic separation is considered. (J.S.R.)

50994 PREPARATION OF CARRIER-FREE NIOBIUM AND TECHNETIUM FROM PROTON-IRRADIATED ENRICHED TARGETS. Shiokawa, Takanobu; Yagi, Masuo; Sasaki, Teikichi; Hishinuma, Noboru (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., First Ser., 50: 214-17(Dec. 1967).

Improved procedures were developed for the preparation of carrier-free ^{96}Nb and ^{99}Tc from proton-irradiated enriched Zr and Mo targets by anion exchange methods, making it possible also to recover the enriched targets. The results showed that radiochemical purities, yields of activity, and recoveries of target material were satisfactory. Enriched Zr and Mo oxides were mixed with glycerin phthalate resin (glyptal) in ethyl acetate, and mounted on an Al plate, which was then dried at 150°C. The plate was covered with a thin foil of Ta (15 μ), and irradiations were carried out in the 163-cm cyclotron using protons of various energies ranging from 10 to 14 MeV for 4 to 6 hr. One hr after irradiation, the target (30 mg) was mixed with about 10 times its weight of $KHSO_4$, and heated until fused. After solution in 1M, precipitation of the hydroxide was carried out with NH_4OH solution, and the precipitated hydroxide was dissolved in concentrated HCl. The solution was passed through a column of Dowex 2 × 8 in Cl form. Niobium activity on the column was eluted with 3 to 4 column volumes of 4M HCl. (BBB)

50995 ESR STUDY ON COLOR CENTERS IN SILICATE GLASS INDUCED BY IONIZING RADIATION. Morikawa, Masahiro; Nishiraku, Takashi (Mitsubishi Electric Corp., Japan). Mitsubishi Denki Lab. Rep., 42: 1051-9(Aug. 1968). (In Japanese).

A study has been made on color centers in alkali silicate glasses induced by x or uv radiation by comparing the optical absorption spectra with ESR spectra. X radiation from a W anode was used as the source of irradiation. The effects of melting condition on coloration and the ESR of x-ray or uv irradiated glass suggest that the optical absorption bands, A-band ($\lambda_{max} \approx 620$ mμ) and B-band ($\lambda_{max} \approx 450$ mμ), have a relation to color centers with trapped hole. Thermal bleach experiments on x $K_2O \cdot (100\text{-}x)$ SiO_2 irradiated with x rays and low temperature optical bleaching experiments on 30 $K_2O \cdot 70$ SiO_2 x irradiated at 77°K indicate that the A-band is due to the trapped hole center HC_2 with axial symmetry and that the B-band of $\lambda_{max} \approx 475$ mμ consists of 2 overlapping absorption bands of $\lambda_{max} \approx 500$ mμ and $\lambda_{max} \approx 440 \sim 450$ mμ; the former is due to the trapped hole center HC_1 with lower symmetry than axial one, while the latter being independent of ESR of trapped hole centers (HC_1 and HC_2 named by Schreurs) in a $g \approx 2.0$ region. (NSA of Japan)

50996 EFFECT OF RADIATION ON EPOXY RESINS. Yamaguchi, Hiroyuki; Akimoto, Osamu (Fuji Electric Co., Ltd., Japan). Fuji Jiho, 41: 596-601(Aug. 1968). (In Japanese).

Several types of aromatic amines of bisphenol A epoxy resin used widely in electrical insulation materials and acid anhydride hardening samples were exposed to radiation ($10^7 \sim 6 \times 10^7$ RAD) in an atomic reactor. After being exposed to radiation exceeding 10^8 RAD, each sample registered a sudden drop in mechanical and electrical characteristics. At radiation of 10^8 RAD the bending strength at normal temperature hardly changed. However, considerable changes were discovered in the electrical characteristics, especially at high temperature. Radiation resistance of the epoxy resin becomes very large when −C−O bonding of the bisphenol A is replaced by −C−N bonding and the fourth C atom is omitted. Any differences in changing characteristics as related to hardening agents were not large. (NSA of Japan)

50997 THERMOLUMINESCENT GLASS AND METHOD OF PREPARING THE SAME. Ginther, Robert J. (to Secretary of the Navy). U. S. Patent 3,396,120. Aug. 6, 1968. Filed Apr. 30, 1965.

A clear, transparent, colorless glass of Li_2O, Al_2O_3, and SiO_2 sensitized with terbium oxide to yield an efficient thermoluminescence after exposure to high energy radiation is described. In the preparation of the glass, the melting of the ingredients and cooling of the glass melt are conducted in a reducing atmosphere. (Offic. Gaz.)

50998 RADIATION CHEMISTRY OF CYCLOPENTANE. Hughes, Byron Mason. Gainesville, Fla., Univ. of Florida, 1967. 159p.

Thesis.

A study was made of the radiation chemistry of pure cyclopentane and cyclopentane with iodine added as radical scavenger. The following major products were identified by gas chromatographic retention times and mass spectral cracking patterns and their G-values reported: hydrogen, methane, ethylene, ethane, propylene, propane, cyclopropane, 1-pentene, n-pentane, cyclopentene, and bicyclopentyl. The method of scanning several masses simultaneously using the Bendix Time-of-Flight mass spectrometer was used to identify the following minor radiolysis products; 1,4-pentadiene, 2-pentene-cis and trans, cyclopentadiene, 1,3-pentadiene-cis and trans, vinyl cyclopentane, ethyl cyclopentane, n-heptane, n-octane, propyl cyclopentane, propenyl cyclopentane, propyl cyclopentene, n-decane, pentyl cyclopentane, pentyl cyclopentene, n-pentyl cyclopentane, and cyclopentyl cyclopentyl cyclopentene. The Runge−Kutta numerical integration technique was used on an IBM 709 computer to fit calculated curves to experimental data for iodine concentration versus radiolysis time in cyclopentane−iodine and cyclopentane−hydrogen iodide mixtures. The value for the ratio of k_{HI}/k_{I_2} for scavenging of alkyl radicals by hydrogen iodide and iodine, respectively was found to be 0.75. The value for thermal hydrogen atoms escaping from the spurs varied from 0.8 to 1.3. Measurements were made of the effects of added iodine on the various yields as a function of iodine concentration. (TSS) (Disser. Abstr.)

50999 CARRIER YIELD IN MOLECULAR SYSTEMS DUE TO PHOTO AND HIGH-ENERGY β PARTICLE IONIZATION. Silver, M.; Jarnagin, R. C. (Univ. of North Carolina, Chapel Hill). Mol. Cryst., 3: 461-9(May 1966).

Recombination in molecular crystals and liquids is considered from the point of view of continuity of current. The observed small quantum yield and the temperature dependence of photoconductivity in anthracene crystals have been attributed to geminate recombination which may also account for the low yield of carriers from x-ray excitation of anthracene crystals. It is assumed that only those electrons which have a range greater than the Coulomb radius may escape from the parent molecule. Thus, under x or β irradiation the high-energy recoil electrons produce secondaries, tertiaries, etc., and of these electrons only those which initially come into thermal equilibrium with the lattice at a distance from a positive center in excess of $e^2/\epsilon kT$ may escape. A model is proposed to account for the efficiency and temperature dependence of charge separation for a group of very dilute carriers in thermal equilibrium with a lattice. The distance just after thermalization between the positive ion and the electron (negative ion) of the same pair is taken as r_0. The probabilities for recombination and dissociation are obtained from boundary conditions expressed in terms of carrier concentrations at $r = 0$ and $r = \infty$. The initial separation, r_0, of the charged pair is determined by the relaxation of an ejected energetic electron to lattice temperature. The model was found to be consistent with experiment in 2 cases and to permit useful estimations and comparisons in others. Comparison between β particle and photoexcitation suggested that initial back recombination between the emitted electron and the parent molecule may not be important in photoconductivity. (BBB)

51000 NUCLEAR MAGNETIC RESONANCE ABSORPTION OF ^{60}Co γ-RAYS IRRADIATED POLYTETRAFLUOROETHYLENE. 2. THE EFFECT OF IRRADIATION-ATMOSPHERE. Tutiya, Mitsuaki; Yamamoto, Kakuji (Tokyo Metropolitan Isotope Research Center). Oyo Butsuri, 37: 718-24(Aug. 1968). (In Japanese).

NMR absorption of polytetrafluoroethylene irradiated with ^{60}Co γ rays with a total dose of about 1.2×10^6 R in the presence of O_2 or N_2, or in a high vacuum and then heat-treated at 300°C in vacuum was measured. A remarkable increase in crystallinity and the step-like broadening of narrow line width above 27°C were observed in the specimens heat-treated after γ irradiation in O_2. In contrast there was no difference in molecular motion between the specimen heat-treated after γ irradiation in N_2 and that in vacuum. This increase in crystallinity is ascribed to the scission of molecular chains following the reaction of $-CF_2-CF_2$ radicals with O. The step-like broadening of line width of narrow component is due to the superposition of narrow component and paracrystalline component, which segregated from broad component in the vicinity of the room temperature transition. The most part of the increase in crystallinity was paracrystalline component produced as a result of the post-irradiation heat treatment. The segregation of paracrystalline component from broad component in the vicinity of the room temperature is due not only to chain alignment in order but also to the transition in molecular motion of the crystalline regions. The paracrystalline component is ascribed to the regions which consist of the shorter polymer chains orderly aligned and affected by the crystalline regions. (NSA of Japan)

51001 PRODUCTION OF ^{13}C BY CARBON MONOXIDE RECTIFICATION. Asatiani, P. Ya.; Kaminskii, V. A.; Oziashvili, E. D.; Tevzadze, G. A. (Tbilisi Scientific Research Inst. of Stable Isotopes, USSR). Isotopenpraxis, 4: 275-7(July 1968). (In Russian).

The advantages of using ^{13}C for chemical and biological investigations are demonstrated. A method of low-temperature countercurrent distillation for this isotope and the column used are described. Special attention is given to the cleaning of the initial

product (CO). In addition, the influence of the heat supply on the gas flow in the cascade and the efficiency of the plant are studied. (auth)

51002 PRODUCTION OF RADIOACTIVE COLLOIDAL GOLD ^{198}Au AT THE BORIS KIDRIC INSTITUTE OF NUCLEAR SCIENCES, VINCA, YUGOSLAVIA. PART 1. A NEW CELL FOR THE PRODUCTION OF RADIOACTIVE COLLOIDAL GOLD ^{198}Au. Draskovic, R. J.; Vukicevic, S. (Boris Kidric Institut des Sciences Nucleaires, Vinca, Yugoslavia). Isotopenpraxis, 4: 271-5 (July 1968). (In French).

A new cell for the production of radioactive colloidal gold ^{198}Au used in medicine for therapeutical and diagnostical purposes was constructed in the Hot Laboratory of the Boris Kidric Institute of Nuclear Sciences at Vinca. Two apparatuses for the production of radioactive colloids of gold were mounted in the cell thus ensuring regular production even in the case of an accident on one of them. The new and original technical solutions of the lead shield of the cell facilitate access to the apparatuses (for replacement) and the stocks for waste waters, while the control system for the chemical processes and the cell is considerably simplified. (auth)

51003 MOLECULAR STRUCTURE AND PHOTOCHEMICAL REACTIVITY. IX. PHOTOLYTIC AND RADIOLYTIC TYPE II ELIMINATION REACTION OF n-BUTYROPHENONES. EFFECTS OF meta SUBSTITUENTS. Pitts, J. N. Jr.; Burley, D. R.; Mani, J. C.; Broadbent, A. D. (Univ. of California, Riverside). J. Amer. Chem. Soc., 90: 5902-3(Oct. 9, 1968).

Some substituent effects on type II process of n-butyrophenones that occur when these compounds are exposed to uv or γ radiation are reported. Values for the quantum yields and radiolysis G-values for the type II process, triplet energies, and phosphorescence lifetimes for substituted n-butyrophenones are tabulated. Results show that the Φ_{II}(quantum yield of acetophenone) values for o- and p-acetoxy-n-butyrophenone were normal, but their phosphorescence lifetimes (τ_p) were considerably longer than those usually found for (n,π^*) triplet states. The o- and p-methoxy derivatives had lower Φ_{II} values, but τ_p was also longer than expected. The most significant result was the striking decrease in Φ_{II} when acetoxy or methoxy substituents were in the position meta to the carbonyl group. This decrase was also accompanied by a considerable increase in τ_p, which suggest that the lowest triplet states for the meta derivatives are (π,π^*) states. (D.H.M.)

51004 EFFECT OF ACETYLENE ON THE γ-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Mitsui, Hiroshi; Hosoi, Fumio; Hagiwara, Miyuki; Kagiya, Tsutomu (Takasaki Radiation Chemistry Research Establishment, Japan). J. Polym. Sci., Part A-1, 2881-8(Oct. 1968).

The effects of acetylene on the γ-induced polymerization of ethylene were studied from the viewpoint of the gaseous products and polymer structure. The experiments were carried out under a pressure of 400 kg/cm^2; the temperature was 30°C; the dose rate was 1.1×10^5 RAD/hr; and the acetylene content was 0 to 20%. The solid polymer was obtained in the polymerization of ethylene containing 2.2% acetylene, while the monomer containing 19.7% acetylene gave a yellowish viscous oil. The polymer yield and molecular weight decreased remarkably with acetylene content. The main gaseous product was hydrogen, and trace amounts of butane, butene-1, butadiene-1,3 and benzene and its derivatives were also observed. The rate of formation of hydrogen was almost independent of acetylene content and there was no difference in acetylene contents before and after the irradiation was found. The infrared spectra of the polymers showed the presence of vinylidene, trans-vinylene, and terminal vinyl unsaturations, 1,4-disubstituted benzene, and carbonyl groups. The contents of trans-vinylene, terminal vinyl, and methyl groups increased with acetylene content, and that of vinylidene was independent of acetylene content. The monomer reactivity ratios of ethylene and acetylene were evaluated as 45.5 and 66.0, respectively. On the basis of the results, the effects of acetylene on the γ-induced polymerization of ethylene were discussed. (auth)

51005 RADIATION-INDUCED NITRATION OF BENZENE. Epstein, W. W. (Univ. of Utah, Salt Lake City); Kust, R. N.; MacGregor, D. D. Chem. Commun., No. 19, 1190-1(1968).

A high-yield method of preparing nitrobenzene from liquid benzene and nitrate salts, using x-irradiation to induce the reaction, is described. Using a mixture of anhydrous KNO_3 and benzene, in a sealed cell with exclusion of air, conversions of up to 95% were obtained. A plot of yield against time is shown. Similar results were obtained with other nitrates. The production of nitrobenzene appeared to be wavelength dependent. The G- value for the reaction was estimated as 39. This high value indicates either a chain reaction involving a chemically active propagating species, or a highly efficient energy transfer process. (UK)

51006 CHEMICAL DETERMINATION OF FREE-ION YIELDS IN IRRADIATED LIQUID HYDROCARBONS. Rzad, Stefan J.; Warman, John M. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys., 49: 2861-2(Sept. 15, 1968).

A chemical method of determining free-ion yield, G_{fi} (ions/100 eV), is reported and the results are compared with those obtained by the clearing-field method. Since the formation of methyl radicals in irradiated methyl bromide–cyclohexane solutions results exclusively from electron capture, methyl bromide was used as solute. For the conditions employed (^{60}Co, γ irradiation; dose rate 8.6×10 eV/cm^3/min) the fate of the methyl radicals is predominantly (97%) hydrogen-atom abstraction from the solvent hydrocarbon to form methane. The yields of methane obtained from solutions of methyl bromide in n-hexane, cyclohexane, and isooctane are reported. When the results were plotted against the square root of the CH_3Br concentration, a linear dependence was observed. The values for G_{fi}, 0.12, 0.12, and 0.34 for n-hexane, cyclohexane, and isooctane respectively, were in good agreement with the results from the clearing-field method. The present technique provides a means of measuring free-ion yields that may be of particular use in polar media for which measurement by conductivity or clearing-field methods is difficult. (D.H.M.)

51007 γ-RADIOLYSIS OF ETHYLENE GLYCOL AQUEOUS SOLUTIONS. Ahmad, Mukhtar; Awan, Mohammad Hussain; Mohammad, Din (Atomic Energy Centre, Lahore). J. Chem. Soc., B, No. 9, 945-6(1968).

γ radiolysis of aqueous solutions of ethylene glycol (1×10^{-3}M) with oxygen (1×10^{-3}M) gave hydroxyacetaldehyde and hydrogen peroxide as the only products. G(Aldehyde) = 2.6 was independent of pH, as shown by experiments conducted at pH 5.5 and 2.0. G(Hydrogen peroxide) = 3.6 was higher than the predicted value of $G(H_2O_2) + \frac{1}{2}G$(reduction). A mechanism for the formation of both hydroxyacetaldehyde and excess of hydrogen peroxide is suggested. (auth) (UK)

51008 DISTINGUISHABLE ELECTRON TRAPS IN γ-IRRADIATED n-PROPANOL GLASS. Dainton, F. S.; Salmon, G. A.; Zucker, U. F. (Univ. of Leeds, Eng.). Chem. Commun., No. 19, 1172-4(1968).

Data are reported which show that γ-irradiated n-propanol glass contains trapped electrons which differ in trap depth, and in response to heat and light. The glasses were studied by low temperature spectrophotometry; the lowest attainable temperature in the spectrophotometer cell was 78°K. Photobleaching experiments were carried out in situ. The irradiated glasses (containing 2% water v/v) showed a broad intense optical absorption (λ_{max} = 555 nm), assigned to e_t^-. Plots are shown of loss of absorption on holding successively for 5 min periods at 85, 94, 101, and 104°K; also loss of absorption caused by thermal treatment <104°K, and spectrum of centers destroyed above 104°K; also changes caused by illumination. Results clearly indicated that the radioinduced absorption band due to e_t^- is composed of a large number of absorption bands of similar shape but different λ_{max}. The observed difference in the absorption spectra of trapped electrons must be attributed to difference in their trapping sites. Mechanisms are discussed. (UK)

51009 PROCESSES IN γ-IRRADIATED METHANOL GLASS. Dainton, F. S.; Salmon, G. A.; Wardman, P. (Univ. of Leeds, Eng.). Chem. Commun., No. 19, 1174-6(1968).

Observations on the γ radiolysis at 77°K of methanol glass containing 2.3 vol % water were extended, and a mechanism is presented which forms a consistent pattern with those for other low-temperature glasses. Relevant observations are described in detail. (UK)

51010 ON THE DIELECTRIC BREAKDOWN AND DETERIORATION OF POLYETHYLENE. THE IRRADIATION EFFECTS. Tanaka, Toshikatsu (Central Research Inst. of Electric Power Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku, No. 67027, 1-23(June 1967). (In Japanese).

The dielectric breakdown and deterioration of polyethylene was studied with particular interest in the change of molecular structure by electron irradiation and in the change of molecular motion by the temperature. Polycarbonate was also studied. Dividing the over-all mechanism of its dielectric breakdown in three temperature ranges, viz., below the glass transition temperature, below about the melting point down to the transition temperature, and in the vicinity of the melting point, each mechanism in the respective regions were examined. In the vicinity of the glass transition temperature, the theory of mechanical-electrical breakdown was "negative." The investigation of the effects of temperature, electron irradiation and crystallization showed that deep and shallow electron traps probably had a large influence on the dielectric breakdown. The existence of these two kinds of electron trap are

now being confirmed by means of light transmission. (NSA of Japan)

51011 RADIOLYSIS OF AQUEOUS SOLUTIONS OF ETHYLENE. Basson, R. A.; Du Plessis, T. A. (Atomic Energy Board, Pretoria). Radiat. Res., 36: 14-21(1968).

The products of the radiolysis of deaerated aqueous solutions of ethylene at atmospheric pressure are butane, hexane, octane, decane, acetaldehyde, butyraldehyde, ethanol, butanol, and hydrogen peroxide. Product yields, especially those of the aldehydes and hydrogen peroxide, increased with increasing ethylene concentration and decreased with increasing pH and radiation dose. Addition of efficient electron scavengers increased the yields of oxidized products and decreased the yields of reduced products. The results were compatible with a mechanism in which OH radicals add to rather than abstract from ethylene. Computer-aided analysis of the kinetics of competing reactions indicated that the low yields of aldehydes are related to the ability of these compounds to act as internal scavengers of solvated electrons. (auth)

51012 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF BUTADIENE ON POLYETHYLENE BY TRAPPED RADICALS. Furuhashi, Akira; Mukozaka, Hiroshi; Matsuo, Hiroshi (Nippon Telegraph and Telephone Public Corp., Ibaraki, Japan). J. Appl. Polym. Sci., 12: 2201-12(Oct. 1968).

The low-temperature grafting of butadiene on polyethylene (PE) preirradiated in air is compared with that on PE preirradiated in vacuo for the effect of several factors on the grafting. Little fundamental difference between the two cases was observed. In both cases the graft conversion curve is trapped radical type and the overall activation energies are 9.7 and 8.4 kcal/mol for 0.947-density PE and 0.916-density PE, respectively. Per cent grafting is proportional to the square root of the dose rate (= total dose). The retarding effect of oxygen at irradiation or storage after irradiation on the grafting scarcely appears when the irradiation temperature or storage temperature is below 15°C. For thinner film and lower density of PE this effect appears clearly at the higher temperature. Therefore, it may be concluded that the low-temperature grafting of butadiene onto PE preirradiated in air is initiated predominantly by nonoxidized radical (allyl radical) trapped in PE and that the grafting reaction occurs in the semicrystalline part of PE. (auth)

51013 ABSOLUTE RATE CONSTANTS OF RADIATION-INDUCED POLYMERIZATION OF ISOBUTYL VINYL ETHER. Ueno, Katsuji; Hayashi, Koichiro; Okamura, Seizo (Kyoto Univ.). J. Macromol. Sci., Part A2: 209-14(Jan. 1968).

The pulse-irradiation method, which is based on the same principle as the rotating sector method widely applied for radical polymerization, is applied to the radioinduced free ionic polymerization of isobutyl vinyl ether (IBVE) because of half-order dependence of the polymerization rate on the irradiation intensity. The radioinduced polymerization of IBVE proceeds by a radical mechanism in a wet system and by a cationic one in a dry system. Much effort was made in the drying of IBVE, and better reproducibility was obtained on polymerization. Irradiation was done by x rays from a Van de Graaff accelerator (1.5 MeV). At the conditions of 5.3×10^4 RAD/hr and 42.5°C, k_p was estimated to be 1.1×10^8 l/mole/sec. This value is similar to the value obtained from the conductivity method ($k_p = 3.4 \times 10^5$ l/mole/sec at 1.32×10^{15} eV/g/sec and 30°C). Although measuring lifetime by the pulse-irradiation method under x-ray irradiation has some experimental difficulties, it provides a powerful method for analyzing polymerization mechanisms by free ions. (BBB)

51014 SOLVATED ELECTRON IN ACETONITRILE. Singh, A.; Gesser, H. D.; Scott, A. R. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Chem. Phys. Lett., 2: 271-3(Sept. 1968).

The formation of the solvated electron in acetonitrile was observed by pulse radiolysis and by flash photolysis of solutions of N,N,N',N'-tetramethylphenylenediamine and indole in acetonitrile. Addition of biphenyl and carbon tetrachloride provides evidence of scavengeable electrons in the solutions. (auth)

51015 ^{60}Co RAY IRRADIATION OF STARCH. Horitsu, Keisuke (Hirosaki Univ., Japan). Hirosaki Daigaku Nogakubu Gakujutsu Hokoku, No. 14, 7-8(Mar. 1968).

Potato starch was irradiated with ^{60}Co γ rays at 200 krad (dose rate: 100 krad/hr) and 1500 krad (dose rate: 1000 krad/hr). It was found that γ irradiation may change the structure of the starch, and the dose rate may be an important factor in this change. (NSA of Japan)

51016 RADIATION HIGH-POLYMER CHEMISTRY. Iwasaki, Machio; Hayakawa, Jo (Government Industrial Research Inst., Nagoya, Japan). Kogyo Gijutsu, 9: No. 2, 21-5(Feb. 1968). (In Japanese).

Developments in high-polymer chemistry using radiations at the Government Industrial Research Institute, Nagoya are described. This includes: initial stages in the radiation chemical reactions; radiation polymerizations; radiation graft copolymerizations; and radiation effects in high polymers (bridging and dissociation, radiation-bridged high polymers, and radiation-dissociated high polymers). (NSA of Japan) (TSS)

51017 STUDIES ON RADIOLYSIS OF FATS WITH EMPHASIS ON FISH OIL. Dubravcic, Milan Frane. Amherst, Mass., Univ. of Massachusetts, 1968. 92p.

Thesis.

Fish oil and synthetic triglycerides were employed to investigate the mechanism responsible for the formation of volatile compounds in fats by irradiation. Volatile compounds present naturally in mackerel oil as well as those produced in oil by radiolysis were isolated by vacuum distillation and analyzed by gas liquid chromatography and mass spectrometry. The following compounds were produced by irradiation under vacuum: normal alkanes (C_1 to C_{17}), 1-alkenes (C_2 to C_{17}), internal alkenes (C_{14} to C_{21}), alkadienes (C_{12} to C_{21}), hendecyne, heptadecatriene, hexadecanal, hexadecenal, octadecanal, and octadecenal. Fish oil was exposed to radiation from cobalt-60, carried out at two temperatures (0 and 25°C) and at three dose levels (0.3, 2.0, and 6.0 megarads), and the quantities of hydrocarbons produced were measured for each temperature and dose level. The products formed increased linearly with dose; at 25° the amounts of product were approximately 3 times as much as those at 0°C. The composition of the quantities of hydrocarbons produced with the composition of fish oil indicated specific routes of radiolytic decomposition of the glyceride fatty acids. These observations were confirmed and extended by the study of model compounds. Four major hydrocarbons were obtained by radiolysis of each saturated and unsaturated triglyceride. The structure of the products indicated that they were derived from the parent fatty acid as follows: two hydrocarbons by the loss of no. 1 carbon atom and two hydrocarbons by the loss of no. 1 plus no. 2 carbon atom of the fatty acid; within each pair one member had a terminal double bond. Saturated triglycerides yielded four additional major derivatives of the parent fatty acid: alkanal, alkenal, methyl ester and ethyl ester. Unsaturated triglycerides yielded the corresponding two aldehydes but no ethyl ester; the production of the methyl ester was uncertain. A mechanism is proposed for the formation of the major products of radiolysis of triglycerides. (Disser. Abstr.) (TSS)

51018 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATIONS. XXIII. POLYMERIZATION OF VINYLENE CARBONATE. Hardy, G.; Nyitray, K.; Cser, F.; Nagy, A. (Research Inst. for Plastics, Budapest). Eur. Polym. J., 4: 289-95(Apr. 1968).

Kinetic curves of solid-state, radioinduced polymerization of vinylene carbonate are presented for various temperatures. The polymerization curves at constant temperature with various dose rates of irradiation demonstrate that the kinetic curves of the solid-state polymerizations are initially linear, bend at 15% conversion, and show acceleration beyond 20% conversion. Curves for −21°C and for 7.5×10^3 RAD/hr dose rate at 0° were exceptional since the solid-state polymerization was slow due to the low temperature and the low dose-rate. The accelerated stage of the reaction is, therefore, reached only after a much longer period of irradiation. Specific viscosities of the polymers formed up to various conversions, i.e., in samples irradiated with various dose rates, are shown. The relation found suggests that the molecular weight of polymer formed up to a conversion of about 20% is independent of the conversion and decreases as the dose rate is increased. The molecular weight increases when the solid-state polymerization is carried on in the accelerating region. Thus, the course of the solid-state polymerization of vinylene carbonate is unique and completely different from cases reported so far. Presumably, up to a conversion of ~15 to 20%, the location of the monomer molecules in the crystal lattice permits the polymer chains to grow without leaving the lattice. Polymerization then proceeds at a considerably higher rate up to a conversion of about 70% because of increased mobility of the monomer at the polymer-monomer interfaces. (BBB)

51019 RADIATION-CHEMICAL REACTOR FOR SULFOCHLORINATION OF PARAFFIN HYDROCARBONS PC-2.5. Osipov, V. B.; Dzhagatspanyan, R. V.; Shtan, A. S.; Simonov, V. M.; Mamikonyan, S. V.; Solodikhina, L. D.; Bodrov, D. P.; Golubkov, S. V.; Lyaskin, Yu. G. At. Energ. (USSR), 25: 271-4(Oct. 1968). (In Russian).

Methods for calculating radiation dosage fields in the reactor

are represented. The design of the operating radiochemical reactor for carrying out the chain chemical process of the paraffin hydrocarbon sulfochlorination is described. The main reactor units are: a storage for ^{60}Co sources which are capsuled in spherical unseparable cassettes made of stainless steel, a distributing device which connects the sources storage with the irradiator and which makes possible assembling the irradiator of any activity, a biological shield, and the reactor tank with ducts which follow through the biological shield into the technological communications. The total irradiator activity is about 1,600 curie. (auth)

51020 ENERGY-INDUCED CHANGES IN AN AZO DYESTUFF WASTE. Mytelka, Alan I. (Ritter Pfaudler Corp., Princeton, N. J.); Manganelli, Raymond. J. Water Pollut. Contr. Fed., 40: 260-8(Feb. 1968).

In the presence of oxygen, irradiation of large organic molecules in aqueous solution can cause oxidation and fragmentation. On this basis, it was thought that effluents containing organic molecules toxic or refractory to the microorganisms found in biological treatment plants might become more biodegradable if subjected to ionizing radiation. A study of radioinduced changes in an industrial waste and of the effects of these changes on subsequent biological oxidation of the waste was made. The waste, an azo dyestuff mother liquor, was chosen because of its low biodegradability, chemical complexity, and intense color. Cobalt-60 sources of 1500 and 4000 Ci (each divided into 8 encapsulated pencils) were used. Three different levels of dissolved oxygen in the waste were maintained by varying the ratio of oxygen to nitrogen in the gas bubbled through the waste during irradiation: 0% oxygen–100% nitrogen, 40% oxygen–60% nitrogen, and 100% oxygen–0% nitrogen. The conditions of irradiation were pH 11.1, dose rate 0.17 Mrad/hr, total dose 0.69 Mrad, and a nominal 100 : 1 dilution of the waste. The dissolved oxygen content of the waste had relatively little effect on its oxidation. For example, the reduction of the COD (chemical oxygen demand) with no oxygen present was 16.9% while the COD reduction when 100% oxygen was bubbled through the waste was 22.5%, a 33% increase. The same increase was observed in the percent dye degraded. Although oxygen plays a role in the reaction mechanisms, it evidently does not promote a long-chain reaction. The radioinduced oxidation of the azo dyestuff waste was favored by alkaline conditions, with maximum oxidation occurring at pH 11. As the dose of γ rays increased, the COD, total organic carbon concentration, dye concentration, and color of the waste decreased, and the dye became more amenable to biological oxidation. (BBB)

51021 RADIOLYSIS OF METHYLCYCLOPENTANE. III. LIQUID PHASE MECHANISM AND COMPARISON OF CYCLOALKANES. Freeman, Gordon R.; Stover, E. Diane (Univ. of Alberta, Edmonton). Can. J. Chem., 46: 3235-40(Oct. 15, 1968).

The initial yields of the major products of the γ radiolysis of liquid methylcyclopentane (MCP) at 25°C are: $G(H_2)$ = 4.2, G(1-methylcyclopentene plus methylenecyclopentane) = 2.7, G(3- plus 4-methylcyclopentene) = 1.0, G(open chain hexene) = 1.0, and G(bimethylcyclopentyl) = 0.9. The effects of scavengers on the product yields are reported and the mechanism is discussed. The liquid phase radiolytic decompositions of cyclohexane (CH), methylcyclohexane (MCH), cyclopentane (CP), and MCP are compared. The net amount of C–C bond cleavage is much greater in the five-membered than in the six-membered rings. Methyl substitution on the ring reduces $G(H_2)$ by about one unit, mainly because of the formation of a type of ion (QH^+) that does not yield hydrogen when neutralized by an electron. The QH^+ type ions are formed in MCH and MCP, but not in CH and CP. In all the systems, another type of ion (N^+) that does not yield hydrogen when neutralized by an electron is formed with a G value of about unity. The type of ion (PH^+) that does yield hydrogen when neutralized by an electron has a G value of 3.4 in CH and CP, but only 2.0 in MCP. It is concluded that G(total ionization) is in the vicinity of 4.4 in the liquid compounds, virtually the same as the gas phase values. (auth)

51022 RADIOLYSIS OF THE MIXTURE Fe^{2+}–Fe^{3+}–O_2–Cu^{2+} IN AQUEOUS AND SULFURIC ACID SOLUTION. Mantaka, Anastasia; Koulkes-Pujo, Anne-Marie (Institut de Physique Nucleaire, Paris). J. Chim. Phys., 65: 1291-1300(July-Aug. 1968). (In French).

Copper sulfate is a good scavenger of H and HO_2 radicals and oxygen a good scavenger of H. The system Cu^{2+}–O_2–Fe^{2+}–Fe^{3+} was used to determine the ratio of the rate constants for the reaction of HO_2 with Cu^{2+} and Fe^{2+}. Experimental conditions were chosen for favorable observation of the "double competition" indicated by the following reactions: 1) $Cu^{2+} + H = Cu^+ + H^+$; 2) $O_2 + H = HO_2$; 3) $Cu^{2+} + HO_2 = Cu^+ + H^+ + O_2$; 4) $Fe^{2+} + HO_2 = Fe^{3+} + HO_2^-$. The Cu^+ is probably oxidized by Fe^{3+}, since only Cu^{2+} is found after irradiation. Kinetic analysis of the reaction scheme gives a relatively simple expression for $G(Fe^{3+})$ in function of $(Cu^{2+})/(O_2)$. Experimentally, however, $G(Fe^{3+})$ was not found to be a linear function of $(Cu^{2+})/(O_2)$, so that more complex kinetics must be assumed. Other reactions of the intermediate Cu^+ are suggested, such as competition between Fe^{3+} and O_2 for the Cu^+. Inclusion of this competition gave complex kinetic expressions which were fitted to the experimental results by means of an electronic computer. The ratios of the rate constants thus obtained were $k_1/k_2 = 0.3$ and $k_3/k_4 = 0.4$. (auth)

51023 IRON PENTACARBONYL AS ENERGY ACCEPTOR IN THE γ RADIOLYSIS OF CYCLOHEXANE AND BENZENE. PART 4. RADIATION-CHEMICAL INVESTIGATIONS OF METAL CARBONYLS. Barzynski, Helmut (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys. Chem. (Frankfurt), 60: 185-90(July 1968). (In German).

The action of ^{60}Co γ radiation on dilute solutions of iron pentacarbonyl in cyclohexane and benzene was investigated. The G values of the products was dependent on the mixing ratio of the two hydrocarbons as well as additions of N_2O, stilbene, and benzophenone. $Fe_3(CO)_{12}$ was formed in large amounts only in pure cyclohexane. $Fe_2(CO)_9$ formed in both aliphatic and aromatic hydrocarbons. (tr-auth)

51024 PHOTOCHEMICAL BEHAVIOR OF THE HEXACHLOROTECHNETATE(IV) ION. Koyama, Mutsuo; Kanchiku, Yoshihiko; Fujinaga, Taitiro (Kyoto Univ.). Coord. Chem. Rev., 3: 285-91(May 1968).

When $(NH_4)_2TcCl_6$ at different concentrations in HCl is irradiated with visible or uv light, the absorption spectra of the solutions change. Eventually an equilibrium, dependent on both HCl concentration and light intensity at constant temperature, is reached. Species separated from 3M HCl after photolysis are $TcCl_6^{2-}$, $TcCl_6^{3-}$, $Tc(OH_2)Cl_5^-$, and $Tc(OH_2)Cl_5^=$. The aquation reaction $TcCl_6^{3-} + OH_2 \rightarrow Tc(OH_2)Cl_5^- + Cl^-$ occurs at least in the early stage of the photolysis, at 2 wavelengths with different quantum yields, 2.49×10^{-1} at 253 mμ and 6.35×10^{-2} at 340 mμ, in 1.1M $HClO_4$ free of Cl^-. The quantum yields of the aquation reaction depend inversely on the concentration of Cl^- in the solution. The first excitation step should be a type of charge transfer process, but the main reaction is aquation, evolution of Cl. After aquation, $Tc(OH_2)Cl_5^-$ can exist in the strongly acidic solution. If the pH of the solution becomes <1, yellow $Tc(OH_2)Cl_5^-$ decomposes into a brownish species, which may involve the dissociation of protons from the water molecule attached to Tc. Cationic and neutral species were detected in the hydrolytic products of $TcCl_5(OH_2)^-$. This is still photochemically active in >1M HCl, yielding a green species, tentatively assigned as $TcCl_4(OH_2)_2$. The green complex is also easily hydrolyzed giving a brown species which eventually precipitates TcO_2. Both $TcCl(OH_2)^-$ and $TcCl_4(OH_2)_2$ were susceptible to oxidation, TcO_4^- being the product after some time. (BBB)

51025 RADIOLYSIS OF ORTHO- AND META-TERPHENYL. Boyd, A. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Tomlinson, M. Can. J. Chem., 46: 3129-36(Oct. 15, 1968). (AECL–2730).

Investigations of the radiolytic decomposition of ortho- and meta-terphenyl by reactor radiation with varying proportions of fast neutrons and gamma rays and of meta-terphenyl by 1.3 MeV electrons in the temperature range 100 to 450°C with radiation intensities from 0.01 to 2 MRADs/s are reported. The observations indicate two regions of radiolytic decomposition with a transition zone at 350 to 400°C. In the lower temperature region, G(decomposition) varied little with temperature, increased with linear energy transfer (LET), was independent of intensity, and yielded mainly high boiling products. Particular attention was given to the high temperature region, where G(decomposition) increased rapidly with temperature, was independent of LET was greater at low intensities than at high intensities, increased with increased pulse frequency for intermittent irradiation, and yielded a greater proportion of benzene and biphenyl. Thermally initiated reaction appeared unimportant except in the absence of radiation. A reaction sequence is given which accounts for these observations in terms of reactions of radical precursors and radicals of the cyclohexadienyl type. A chain reaction occurs in the higher temperature region. (auth)

51026 KINETICS OF GAMMA RADIOLYSIS OF SINGLE CRYSTALS OF GLYCINE AND TRIGLYCINE SULFATE (TGS). Shul'ga, S. Z.; Smirnaya, N. M.; Zver'kov, L. S. (Inst. of Physics, Kiev). Ukr. Fiz Zh., 12: 1559-61(1967). (In Russian).

Single crystals of glycine and triglycine sulfate (TGS) were given a maximum, ^{60}Co, gamma dose of $< 10^5$ R, since TGS still retains its ferroelectric properties after irradiation at this limiting dose. All samples were irradiated at 77°K, and electron paramagnetic resonance (EPR) spectra were taken at 77°K before and after annealing, which was carried out at 293°K. The TGS spectrum showed a well-resolved triplet with intensity ratios between the compo-

nents of 1 : 2 : 1. This behavior indicates the proton nature of the splitting. After prolonged storage at 293°K the appearance of the spectrum changed with the resolution becoming worse. Since the triplet structure did not depend on temperature, it can be ascribed to a carbon radical containing an alkyl group and two hydrogen atoms. The structures of the final radiolysis products of glycine and TGS at 293°K did not correspond with the radical structures which were stabilized at 77°K. A detailed study of the kinetics of gamma hydrolysis is being continued. (TTT)

51027 GASEOUS ^{66}Ga SOURCE. Wechter, M. A.; Schmidt-Bleek, F. (Purdue Univ., Lafayette, Ind.). Int. J. Appl. Radiat. Isotop., 19: 775-6(Oct. 1968).

A gaseous gallium-66 source was obtained by irradiating copper targets with 18-MeV alpha particles in the Purdue University 37-in. cyclotron. The target was dissolved and the gallium extracted as $GaCl_4^-$. The extract was converted to GaI_3 in a sealed ampoule. At 220°C the activity distribution was found to be proportional to $\sqrt{r}$ for the entire ampoule, indicating that vaporization had taken place. (UK)

51028 GAMMA-RAY-INDUCED AMINATION OF BENZOIC ACID IN AQUEOUS AMMONIA SOLUTION. Sakumoto, Akihisa (Japan Atomic Energy Research Inst., Tokyo). Nippon Kagaku Zasshi, 89: 719-20(July 1968). (In Japanese).

The irradiation of an aqueous ammonia solution of ^{14}C-carboxyl labelled benzoic acid was carried out with ^{60}Co γ-rays at the dose rate of 6.7×10^{17} eV/g./min. and the absorbed dose of 4.4×10^{20} eV/g. Products were measured by using an isotope dilution method. G-values of aminobenzoic acids were: ortho, 0.011; meta, 0.013; and para, 0.017. Therefore, the G-value ratio of o- : m- : p-aminobenzoic acid was 0.65 : 0.76 : 1. The production of aminobenzoic acids was about a half of hydroxybenzoic acids produced in aqueous ammonia solution. From the ratio of relative partial rate factors, it was deduced that the amino radical · NH_2 was involved in amination of benzoic acid. (auth)

51029 PRIMARY RADIATION PROCESSES. Kroh, Jerzy (Lodz Polytechnic Inst., Poland). Wiad. Chem., 21: 803-17(Dec. 1967). (In Polish).

Several mechanisms have been proposed for explaining primary processes taking place during exposure to ionizing radiation. The earlier view that the events may be attributed to a single factor has been abandoned; it is now assumed that three processes—ionization, free radical reactions, and excitation processes—must be taken into account. The course of reactions were studied in hydrocarbons, exposed to the γ radiation of a ^{60}Co source, in which the hydrogen atoms were substituted by deuterium and tritium. Results indicated that irradiated benzene saturated with tritiated water retained some activity after removal of the water. Similar studies were carried out on halogenated benzene + THO mixtures. Examination of the radiolysis of benzene–ethanol mixtures revealed the relative importance of ionization and excitation processes. (TTT)

51030 EFFECT OF ELECTRON IRRADIATION AND OF LOCAL ELECTRIC FIELD ON THE FORMATION OF POLYMERIC FILMS. Dubinina, E. M.; Spivak, G. V.; Myachin, E. T.; Netishenskaya, G. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1226-31(July 1968). (In Russian).

An attempt was made to find a correlation between small electrical irregularities of a target and polymeric film thickness on bombarding the target with electrons in the presence of an organic vapor which polymerizes under irradiation. Experiments were carried out with germanium-covered silver and gold films on a glass backing, and with a p-n silicon diode. Residual vapor of silicone oil served as the monomer. A difference in polymeric film thickness was observed microscopically in a p-n transition region. Maximum sensitivity to local electric fields was observed at a contact potential difference of 0.07 volts in the semiconducting silicon diode. The variation in thickness of the polymeric film reflected the initial electrical inhomogeneity of the sample. (TTT)

51031 EFFECT OF SOLVENTS ON THE GRAFT COPOLYMERIZATION BY PREIRRADIATION TECHNIQUE. Munari, S.; Tealdo, G.; Vigo, F.; Rossi, C. (Centro Nazionale Chimica delle Macromolecole, Genoa). Eur. Polym. J., 4: 241-8(Apr. 1968).

In graft copolymerization by the pre-irradiation technique, the amount of grafting was a function of the concentrations of radicals and monomer and of the duration and temperature of post-polymerization. The amount of preformed radicals after irradiation spontaneously decreased and its decay rate was a function of the polymeric matrix properties. Grafting on polypropylene by pre-irradiation and exposure to some monomer-solvent mixtures showed that mutual interactions between the polymeric matrix and the monomer-solvent mixtures are of the greatest importance. The system polypropylene/4-vinylpyridine–ethanol was studied. Mixtures of solvent on monomer were added to the preirradiated polymer at selected temperatures. The behavior of the polypropylene in this monomer-solvent mixture is shown. For concentrations lower than 50% of 4-vinylpyridine in ethanol, there was practically no swelling and swelling took place only when the 4-vinylpyridine concentration exceeded 50%. In the system polypropylene/ethanol-4-vinylpyridine the grafting yield increased with concentration of monomer but there was no linear relation between the monomer concentration and grafting yield. The initial rates of grafting showed anomalies in the region in which the swelling properties of the mixture were greatly changed. In other experiments, the system polypropylene/4-vinylpyridine-benzene was examined, wherein benzene greatly swelled the polymeric matrix. (BBB)

51032 RADIATION-INDUCED POLYMERIZATION OF PROPYLENE OXIDE. Tabata, Yoneho; Fujita, Yoshio; Oshima, Keichi (Tokyo Univ.). J. Polym. Sci., Part B, 6: 715-20 (Oct. 1968).

The radioinduced polymerization of propylene oxide in methylene chloride and 2-methyltetrahydrofuran (2MTHF) initiated by γ-rays or electrons is reported. It was found that polymerization proceeds more rapidly in methylene chloride than in 2MTHF, and the mechanism of polymerization is considered to be cationic for the former case and anionic for the latter. The polymerization of propylene oxide in methylene chloride was not inhibited by radical scavengers, but the polymerization was strongly retarded by acetone and methanol. The polymerization was accelerated by the addition of tetracyanoethylene and was strongly inhibited by adding dimethylformamide. The polymerization of propylene oxide in 2MTHF was not affected by the addition of acetone. It was concluded that polymerization of propylene oxide can proceed in only glassy state at low temperatures. (D.H.M.)

51033 POLYMERIZATION OF TRIOXANE BY THE ACTIVE SPECIES FORMED IN THE IRRADIATED MONOMERS. Ishigaki, I.; Ito, A.; Hayashi, K. (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part B, 6: 727-32(Oct. 1968).

An investigation of the polymerization of nonirradiated trioxane and tetroxane showed that nonirradiated monomers could be polymerized in the solid state by contact with irradiated monomers. Differences were observed in the polymer yields between the following 4 cases (a) irradiation and polymerization were both carried out in vacuo; (b) both in air; (c) irradiation in air and polymerization in vacuo; and (d) irradiation in vacuo and polymerization in air. Results show that the antecedents of the nonirradiated monomer affected the polymerization reaction. When nonirradiated tetroxane was contacted with irradiated trioxane and the samples were kept at 105°C for 10 hr, the tetroxane polymerized to high yields only when the polymerization was carried out in air. (D.H.M.)

51034 ELECTRON-IMPACT INDUCED REARRANGEMENT REACTIONS OF ORGANIC MOLECULES. Brown, Peter; Djerassi, Carl (Stanford Univ., Calif.). Angew. Chem. Int. Ed. Engl., 6: 477-96(June 1967).

Bond fission by electron bombardment examined by mass spectrometry in the study of structure of organic compounds is reviewed. The importance of isotopic labeling in these studies is emphasized. Hydrogen migrations accompany many mass spectrometric fragmentation processes and a detailed study of these migrations, largely by means of deuterium labeling, has shed much light on electron-impact-induced bond fissions. More recently, it has been found that groups other than hydrogen, such as alkyl, aryl, and hydroxyl, also can migrate after electron bombardment and a discussion is given of such molecular rearrangements among organic compounds. These observations are not only of intrinsic mechanistic interest, but a detailed knowledge of the occurrence of such migration reactions is crucial to the proper interpretation of mass spectra and to the avoidance of misinterpretations in element mapping. (BBB)

51035 METHOD OF MAKING TELOMERS BY MEANS OF NUCLEAR RADIATION. Guernsey, Edwin O.; Smith, William E. (to Mobil Oil Corp.). U. S. Patent 3,398,075. Aug. 20, 1968. Filed Oct. 2, 1963.

A process is described for the production of tertiary alcohols having an odd number of C atoms in the range of 5 to 9 C by irradiating a flowing mixture of isopropanol and ethylene in the vapor phase at a pressure ranging from 0.1 to 10 atm, a temperature of 100 to 300°C, and a mole ratio of isopropanol to ethylene initially in the range from 5 : 1 to 30 : 1. The reactants are irradiated for a period of time ranging from 10 sec to 1 min so that the total dose is about 0.1 to 0.5 MRAD. The alcohols form as a liquid product in which the total G value of the alcohols is in the range of 50 to 300. (Offic. Gaz.)

51036 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. XXI. THE INFLUENCE OF THE CONDITIONS OF CRYSTALLIZATION ON THE SOLID-PHASE POLYMERIZATION OF BINARY EUTECTIC SYSTEMS. Hardy, Gy.; Nagy, G.; Varga, J.; Juhos, J. (Technical Univ., Budapest). Eur. Polym. J., 3: 385-90(Aug. 1967).

Factors influencing the kinetics of radioinduced polymerization of binary solid systems, including the chemical nature of the components, physical structure of the system, conditions of irradiation, and the conditions of crystallization, were studied in the binary system of N-vinylsuccinimide (NVSI) and endomethylene-tetrahydrophthalic acid monoallyl ester (AE). For the kinetic studies, the samples were crystallized in air under specified conditions, and freed of O_2 by flushing with N_2. They were then irradiated and dissolved in dioxane; the polymer was precipitated in methanol, and the yield was determined by the gravimetric method. Phase diagrams of the NVSI-AE systems revealed that a quasi-eutectic range of co-crystallization can be observed, depending on the conditions of undercooling and those of nucleation. The rate of solid phase polymerization changes directly with the proportion of the eutectic. It was ascertained that, in binary systems, the proportion of the eutectic structure, and consequently the observed rate of radioinduced polymerization, is markedly influenced by the tendency of the system to undercooling and by the nucleation during the crystallization. (BBB)

51037 METHOD OF MANUFACTURING IMPROVED POLYOXYMETHYLENE GRAFT COPOLYMERS USING RADIATION. Eguchi, Tamotsu; Okaya, Takuji (to Kurashiki Rayon Co., Ltd.). U. S. Patent 3,398,074. Aug. 20, 1968. Priority date Oct. 8, 1964, Japan.

Polyoxymethylene graft copolymers were manufactured by irradiating a thermally stable polyoxymethylene copolymer of a polymerization degree of not less than 500 with from 10^4 to 5×10^7 R of ionizing radiation and effecting graft polymerization of the irradiated polymer by contact with a radically polymerizable vinyl compound with a graft ratio ranging from 0.5 to 200%. The polyoxymethylene copolymer contains from 0.1 to 15 molar % of a comonomer having C-C linkage selected from the group consisting of alkylene oxides and cyclic formal and vinyl monomers. (Offic. Gaz.)

51038 γ IRRADIATION OF THYMINE DIMERS IN AQUEOUS SOLUTION. Deering, R. A.; Snipes, Wallace (Pennsylvania State Univ., University Park). Biophys. J., 8: 971(Aug. 1968).

Previous work on ionizing radiation action on thymine dimers (TT) is briefly discussed. Thymine dimers in aqueous solution can be split by 34-MeV electrons to give thymine. Also 50-kV x rays split thymine dimers in vitro and in vivo. With TT in vitro, for example, at a dose of 600 KR, 68% of the dimer remained, with the appearance of 25% thymine, 4% urea, and 3% unknown products. It was concluded that thymine in the dimer form was relatively resistant to cleavage (to urea for example) and that such cleavage occurred by x-ray action after dimer splitting. Possibly some of the unknown product at high doses is urea from thymine degradation. In vivo results with TT in the DNA of Enterococcus stei indicate that, for doses as high as 2000 KR, much less dimer cleavage occurs than in in vitro irradiations. Protection of the DNA in vivo by the surrounding environment may explain this result. (BBB)

51039 EFFECT OF SULFUR CROSSLINKS ON RADICAL RECOMBINATION IN IRRADIATED ELASTOMERS. Kvashenko, Yu. Yu.; Kuzminskii, A. S.; Fedoseeva, T. S. (Research Inst. of the Rubber Industry, Moscow). Rubber Chem. Technol., 41: 653-87(June 1968).

The effect of S crosslinking on properties of free radicals induced by γ radiation in vacuo at low temperatures was studied. Natural rubber and vulcanizates of natural rubber with S and thiuram were studied. Vulcanization was performed in a press at 143°C and a specific pressure 1.5 atm with a dose rate of 0.65 MRAD/hr at −196°C. Temperature dependence of radical concentration is described by similar curves for all the specimens' warming curves, with a typical inflection point in the phase transformation range of the polymer. When the polymer goes from the glassy to the elastomeric state, the mechanism of radical decay undergoes considerable change. A marked reduction in radical concentration below T_g was found, this change being greater where the number of S atoms in a crosslink is greater. Radical decay is rapid even at −196° in specimens of S vulcanizates, while it is practically unchanged in raw materials at this temperature. Radical decay is assumed to be due to migration of free valency along and between polymer chains. Above T_g, radical decay is restricted by diffusion of segments of polymer chain. In this range of temperatures neither presence nor the length of S bridges have any particular effect on the intensity of the process. Above T_g, residual radical concentration of raw natural rubber is much higher than for its S vulcanizates at the same temperatures. (BBB)

51040 CONTRIBUTION TO THE PROBLEM OF FORMATION OF UREA IN THE RADIOLYSIS OF THYMINE. Drasil, V.; Ryznar, L. (Inst. of Biophysics, Brno). Collect. Czech. Chem. Commun., 33: 3068-72(Sept. 1968).

In order to determine whether urea is a primary product in the radiolysis of thymine, the formation of urea in irradiated solutions was studied under conditions where the secondary formation was excluded. Ionizing radiation of both low and high linear energy transfer (LET) was used. Cobalt-60 was the source of low LET and ^{210}Po was used for high LET. Results show that urea formed during irradiation amounted to only a fraction of 1% of all radiolytic products. The relative amount of urea was about 1.5 times higher when irradiated in the absence of oxygen. It was concluded that urea was formed in the radiolysis of thymine with a very low yield only, and probably as a consequence of subsequent decomposition of some of the primarily formed substances. Therefore, it cannot play any important role in the radiation damage of DNA. (D.H.M.)

51041 RADIOLYSIS OF SOLID INORGANIC SALTS WITH OXYGEN-CONTAINING ANIONS. Zakharov, Yu. A.; Nevostruev, V. A. (Tomskii Politekhnicheskii Institut, Tomsk, USSR). Usp. Khim., 37: 143-66(Jan. 1968). (In Russian).

The radiolysis of solid salts of nitrogen and halogen oxyacids is reviewed. The production of color in nitrates on γ radiolysis at 4.2, 77 and 300°K has been associated with a number of species; among those proposed for various salts are NO_3, NO_3^{2-}, NO_2, NO_2^{2-}, $N_2O_3^{2-}$, and the stabilized electron. Characteristic EPR spectra of irradiated KNO_3 and $NaNO_3$ are tabulated for various experiments; other nitrates have also been examined. Mechanisms and kinetics are discussed for γ radiolysis, bombardment with energetic α particles, and 44.5-keV x rays. The $G(NO_3^-)$ values for these conditions are tabulated; they show a strong cation dependence, and increase as this is varied from Li to Cs. Thus the cation is strongly involved in the mechanism. The radiolysis of nitrites is briefly discussed. Much of the study of irradiated chlorates, bromates, and iodates has been EPR work; products giving EPR spectra in chlorates include O_3^- (O_2^-), ClO_2, ClO, ClO_3, and $ClO-ClO_3^-$. Yields of products from irradiated MXO_3 are tabulated for different M and X; again there is cation dependence, which is introduced into the proposed mechanism. The radiolysis of alkali and alkaline earth perchlorates is reviewed. (126 references) (BBB)

Radiochemistry

Refer also to abstract 51387.

51042 (CEA-R-3547) STUDY OF GAMMA EMISSION FROM PLUTONIUM. Guezenec, Jean-Yves; Noel, Jean-Paul (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1968. 24p. (In French). Dep.

In order to study problems arising from the handling of plutonium fuel, it is necessary to know exactly the gamma emission spectra of each isotope present. The available literature shows many anomalies, more particularly in the case of ^{240}Pu emission. A table of the main X and γ emission of plutonium isotopes, which may be used for dose calculations, is given; the figures come both from a literature survey and from experimental research. Spectrometry was carried out on a plutonium sample. (auth)

Separation Processes

Refer also to abstracts 50976, 50994, 51134, 51151, 51203, 51204, 52140, 53393, 53395, and 53431.

51043 (ANL-7425) CHEMICAL ENGINEERING DIVISION SEMIANNUAL REPORT, JULY-DECEMBER 1967. (Argonne National Lab., Ill.). May 1968. Contract W-31-109-eng-38. 197p. Dep. CFSTI.

A separate abstract was prepared for each of the 7 sections. (M.C.G.)

For abstracts of individual sections see: 50902, 51044, 51045, 52257, 52556, 53165, and 53260.

51044 (ANL-7425, pp 19-41) COMPACT PYROCHEMICAL PROCESSES. (Argonne National Lab., Ill.).

Laboratory-scale investigations on conceptual pyrochemical process for fast breeder reactor fuels, oxide reduction studies, distribution of elements between liquid alloys and molten salts, and solubilities in liquid alloys are reported. Engineering studies of salt transport separations included exploratory plutonium experiments, extraction in countercurrent columns, materials testing, and salt test facility operations. Results are also given for fuel cycle facility operations. (M.C.G.)

51045 (ANL-7425, pp 42-93) FLUIDIZATION AND VOLATILITY PROCESSES. (Argonne National Lab., Ill.).

Laboratory investigations were carried out on fluorination of UO_2–PuO_2–fission product pellets, adsorption of PuF_6 on NaF, interhalogen–ruthenium reactions, reaction of NpF_6 with NaF, and properties of TeF_6. Engineering-scale investigations were made on recovery of U and Pu from UO_2 fuels in the engineering-scale alpha facility, fluid-bed fluorination procedures, irradiated fuel, and PuF_6 safety. Mechanisms of heat transfer between a fluidized bed and wall and heat transfer in a two-dimensional bed were studied. (M.C.G.)

51046 (EURFNR-499) METAL NITRATE DISTRIBUTION IN $Pu(NO_3)_4$–$UO_2(NO_3)_2$–HNO_3/TBP–DODECANE SYSTEM. Baumgaertel, G.; Ochsenfeld, W.; Schmieder, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Translated from report KFK-680. 22p. (EUR-3707). Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 22-27457.

51047 (KFK-801) FISSILE MATERIAL FLOW CONTROL AT STRATEGIC POINTS IN A REPROCESSING PLANT. von Baeckmann, A.; Gmelin, W.; Gupta, D.; Haefele, W. (Kernforschungszentrum, Karlsruhe (West Germany)). July 1968. 17p. Dep.

With the help of a fissile material balance around a reprocessing plant, it is possible to assess the probability of a diversion after it has taken place. To establish a complete fissile material balance it is essential to determine the amount of fissile material that has flowed into the plant, the amount of material that has come out of the plant, and the amount that remained inside the plant during the same period of time. Reasons for selecting the various strategic points for measurement are discussed. (M.C.G.)

51048 (ORNL-tr-1974) DISSOLUTION OF UO_2 BY THE CHOP-LEACH PROCESS: CHOPPER AND DISSOLVER. Final Report. Jessnitzer, Klaus; Luckan, Johannes; Walther, Hans-Joachim (Leybold-Hochvakuum-Anlagen G.M.B.H., Cologne (West Germany)). Translated for Oak Ridge National Lab., Tenn. from Aufloesen von UO_2 Nach dem Chop-Leach-Verfahren: Chopper und Dissolver. Schlussbericht. 86p. Dep. CFSTI.

The chopper and dissolver were constructed according to the drawings for the Karlsruhe reprocessing plant and tested for functional efficiency. Both parts of the plant can be used for the prescribed tasks and performances. The dissolution of UO_2 and leaching of the cans correspond to the set conditions. Maximum UO_2 losses of 0.1% remain within a tolerable range. Under unfavorable assumptions, the planned chopper system permits a daily throughput of 300 to 400 kg UO_2. With the use of a second chopping system, this daily throughput would increase. The anticipated disassembly of fuel elements and chopping of individual pins would have to be modified for a plant of larger throughput. (auth)

51049 EXTRACTION OF LANTHANIDES WITH A MIXTURE OF THENOYLTRIFLUOROACETONE AND TRIBUTYL PHOSPHATE. Genov, L.; Georgiev, G. (Chemical-Technological Inst., Sofia). Monatsh. Chem., 98: 2214-18 (Dec. 1967). (In German).

A solution of thenoyltrifluoroacetone and tributyl phosphate in CCl_4 was used to extract Pr and Yb nitrates from 0.1N HNO_3 acid. The data indicate the formation of a mixed complex, $M(TTA)_3(TBP)_2$. This leads to a considerable increase in the distribution coefficient, because of a synergistic effect; the extraction equilibrium constant, K, differs greatly from the K for extraction with thenoyltrifluoroacetone along. K_{Yb}/K_{Pr} for TTA is 150; but for the mixed agent it is only 3, and consequently the use of a mixture of extracting agents decreases the separation of lanthanides. Data are given for the distribution coefficient between 0.2M mixed extractant in CCl_4 and aqueous solutions with pH between 1.2 and 2.5. (BBB)

51050 UNIQUE DISPOSAL METHODS ARE REQUIRED FOR URANIUM MILL WASTE. Beverly, R. G. (Union Carbide Corp., Grand Junction, Colo.). Mining Eng., 20: 52-6 (June 1968).

The presence of radioactivity in U mill wastes has resulted in unique waste disposal methods. Special disposal methods or decontamination procedures are required to meet the stringent limitations established by the U. S. Atomic Energy Commission on the concentration of radionuclides in liquid effluents. Of the total radioactivity in U ore, only 1% or less will leave the mill as dissolved α and β activity in the liquid effluent that enters the tailing pond. The total U concentration in the liquid effluent must be maintained below the level of 2×10^{-5} μCi/ml. The dilution of the liquid effluent by streams is large enough that the ^{226}Ra and ^{230}Th concentrations in the stream below the mill are well below drinking water standards. About 14% of the total radioactivity contained in the ore fed to mills is recovered in the U concentrate. The short-lived radionuclides, ^{234}Th, ^{234}Pa and ^{231}Th, are subsequently lost by decay. Approximately 70% of the activity in the ore remains undissolved in the solid mill tailings, which are impounded in a tailing dam. Some U mills located on stream or river drainage areas have no choice but to release liquid to adjacent streams, which is the case at about $\frac{1}{3}$ of the existing U mills. The tailing ponds at the other $\frac{2}{3}$ are of sufficient size that the liquids evaporate or seep into the ground. Six effluent ponds, 1 mi below the Union Carbide Uravan, Colo., U mill, having a surface area of 32 acres and a volume of 70 million gal, dispose of the plant's liquid wastes at an average rate of 175 gpm. The $4\frac{1}{2}$-yr old ponds lose an estimated 15% by evaporation and 85% by percolation to a reservoir in the gravel bed underlying the ponds. (BBB)

51051 PROCESS FOR THE SEPARATION OF ZIRCONIUM FROM HAFNIUM. Glemser, Oskar; von Baeckmann, Adolf U. S. Patent 3,395,976. Aug. 6, 1968. Priority date Apr. 15, 1959, Germany.

A solvent extraction process for the separation of Zr and Hf consists of repeated liquid-liquid extraction of the corresponding chloride salts at between 20 and 60°C by contact between an inorganic phase consisting of an aqueous Cl^- solution which is 2 to 13 N HCl and an organic phase of halogenated hydrocarbon containing a soluble amine having a molecular weight of 150 to 400, such as tribenzylamine. The phases are physically separated, the enriched Zr and any residual Hf are recovered from the organic phase by precipitation, and the organic solvent is recovered from the organic phase. The Hf can also be recovered if desired. (B.L.M.)

51052 ADSORPTION OF RADIOSTRONTIUM ON "CALCIUM PHOSPHATE–ANION EXCHANGE RESIN". Imai, Kiyoko; Watari, Kazuo; Izawa, Masami (National Inst. of Radiological Sciences, Chiba, Japan). J. Nucl. Sci. Technol. (Tokyo), 5: 485-6 (Sept. 1968).

The adsorption of radiostrontium on calcium phosphate anion exchange resin was found to be quantitative for concentrations of Sr up to 10^{-4}M. The adsorption of ^{85}Sr decreased with increasing concentration of alkaline earth metals such as Ca, Mg, and Ba. (J.G.B.)

51053 GAS-CHROMATOGRAPHIC SEPARATION OF ISOTOPE-SUBSTITUTED CARBON HYDRIDES. Sakodynskii, K. N.; Khudyakov, V. L.; Yashin, Ya. I. (Moscow Inst. of Physical Chemistry). Isotopenpraxis, 4: 278-80 (July 1968). (In Russian).

The importance of gas chromatography as a means for stable isotope separation and the present state-of-the-art in gas-chromatographic separation techniques are discussed. Some aspects of the optimization of column operation parameters for the separation of isotope-labeled hydrocarbons and the applicability of capillary columns for gas-liquid and gas-solid chromatography are studied with deuterobenzene-benzene and deuterotoluene–trideuterotoluene–toluene mixtures used as model mixtures. (auth)

51054 EXTRACTION OF STRONTIUM BY AZO-AZOXY BH REAGENT. Gorbenko, F. P.; Nadezhda, A. A. Ukr. Khim. Zh., 34: 625-9 (1968). (In Russian).

The extraction of strontium by solution of azo-azoxy BN in mixture with carbon tetrachloride with 20 vol % tributyl phosphate was studied. It was found that from 0.8 to 2N solution in NaOH and tenfold excess of the reagent, 95% of the Sr was extracted. The extracted complex can be expressed by the formula Sr · AABN · 2TBP. It was established that small quantities of Sr (50 to 100 mkg) can be extracted and determined with error no more than 10 relative %. The extraction of Sr is not prevented by gram quantities of Na, K, Al, Cr, and other elements. (tr-auth)

51055 RADIOACTIVE ISOTOPE DILUTION ANALYSIS. Gorsuch, T. T. RCC Review No. 2. Amersham, Eng., Radiochemical Centre (UKAEA), 1968. 12p.

The technique is described under the following headings: laboratory and material requirements; principle; developments in dilution analysis (derivative dilution, saturation analysis, dilution analysis, and tracer recovery). A number of examples of the application of the technique are given. It is emphasized that the method is capable of a precision and sensitivity often unobtainable by other methods, and is particularly advantageous in handling materials which are liable to decomposition during separation and purification processes. (UK)

51056 THE DISSOCIATION OF HISTONE FROM DEOXYRIBONUCLEOHISTONE BY γ-IRRADIATION. Lloyd, P. H.; Peacocke, A. R. (Oxford Univ.). Biochem. J., 109: 341-6 (Sept. 1968).

Experiments were carried out to determine the extent of dissociation of histone from deoxyribonucleohistone as a result of irradiation with γ rays from ^{60}Co. The bulk of the nucleohistone was removed from the irradiated solutions either by sedimentation or

by precipitation with dilute sodium chloride solution. The supernatants were then analysed for DNA and histone. The ratios of histone to DNA in these supernatants were less than for the original nucleohistone. This indicated that histone was dissociated by the irradiation, and then aggregated either with itself or with other nucleohistone molecules, and so was removed with the bulk of the nucleohistone during sedimentation of precipitation. (auth) (UK)

51057 THE METHOD FOR THE DECONTAMINATION OF WASTES EMPLOYED BY THE INSTITUTE OF APPLIED RADIOCHEMISTRY AT LEIPZIG. Koch, H.; Otto, R.; Hecht, P. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Fortschr. Wasserchem. Ihrer Grenzgeb., No. 3, 137-43(1965). (In German).

The method developed for the purification of radioactive wastes is discussed. Decontamination takes place by addition of $CaCl_2$, $Fe(SO_4)_3$, Na_3PO_4 and follows flocculation at pH 10 to 11. FeS is precipitated. The method permits purification up to 99%; that attained during plant operation is 80%. (tr-auth)

51058 ISOTOPE EFFECT AND ISOTOPE SEPARATION. Kakihana, Hidetake (Tokyo Inst. of Tech.). Nippon Kagaku Zasshi, 89: 734-45(Aug. 1968). (In Japanese).

The values of the reduced partition function ratios for isotopic molecules are calculated from the spectroscopic data on molecular vibrations, based on the statistical mechanics with small quantum corrections. Equilibrium constants for isotopic exchange reactions derived from the results may serve as a basis for further comparative discussion of isotope separation. Theoretical considerations are made on the contribution of chemical reactions to isotope separation, when isotopic substances are distributed in two phases. The resulting fundamental equations can be used to find the most effective system for isotope separation and to estimate isotope effects for each chemical reaction. Interpretations within the framework of the present theory were carried out on the experimental results for the isotope separation of Li, N, Cu, and U with the use of an ion exchanger. (NSA of Japan)

51059 SEPARATION OF MICROGRAM QUANTITIES OF Ce(III) AND (IV) BY THE METHOD OF LAMELLAR CHROMATOGRAPHY. Vagina, N. S.; Fakina, L. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zavod. Lab., 34: 928-30(1968). (In Russian).

The use of radioactive tracers of ^{144}Ce for the separation of Ce(III) and (IV) on silica gel is proposed. Ce(IV) is concentrated on the line of the front of the solvent TBP–benzene. The method was used for the analysis of mixtures of lanthanides. (tr-auth)

51060 PAPER CHROMATOGRAPHY OF THE ELEMENTS THORIUM TO CURIUM, IN HCl AND HNO_3 MEDIA. II. INTERPRETATION OF DATA AND ANALYTICAL APPLICATIONS. Clanet, Frank (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Bull. Soc. Chim. Fr., No. 8, 3491-6(Aug. 1968). (In French).

Results in the field of paper chromatography of elements 90 to 96 are discussed. It has been possible to deduce conclusions concerning the complexing of these elements by Cl^- and NO_3^- ions. Methods are described for the following separations: Th–Pa, Th–U, Th–Np, Th–Pu, Th–Am or Cm, and Pa–U, Np, Pu, Am, or Cm. (P.C.H.)

51061 RESEARCH AND DEVELOPMENT ON AQUEOUS PROCESSING. Stevenson, C. E.; Paige, D. M. Reactor Fuel-Process. Technol., 11: 144-8(Summer 1968).

A method for recovering both actinides and Be from an oxide-type high-temperature gas-cooled reactor (HTGCR) is described; the method is based on successive leaching of the fuel with HNO_3 and H_2SO_4, followed by solvent extraction steps. At the Idaho Chemical Processing Plant, pilot-plant equipment has been installed in easily removable modules having a novel design. Equations have been developed for the design of air-pulsing devices for solvent extraction columns, and their applicability has been confirmed by plant tests. (P.C.H.)

51062 VOLATILITY PROCESSES. Vogel, G. J. Reactor Fuel-Process. Technol., 11: 149-53(Summer 1968).

Developments in studies on a fluid-bed fluoride-volatility process to recover U and Pu values from low-enriched, irradiated UO_2 fuel are described. The steps discussed include: removal of Zircaloy cladding by reaction with HCl; oxidation of the ceramic oxide to a fine powder; fluorination of uranium oxide with BrF_5 to form UF_6, which is volatile, and fluorination of the Pu with F to form volatile PuF_6. The behavior of fission products during the decladding, oxidation, and fluorination steps is described. (P.C.H.)

51063 COMPACT PYROCHEMICAL PROCESSES. Miller, W. E.; Steunenberg, R. K. Reactor Fuel-Process. Technol., 11: 154-8(Summer 1968).

Pyrochemical processes are described for fast breeder reactor fuels and for molten-salt breeder reactor fuel. A summary is given of the steps in the conceptual flow sheet incorporating some continuous contacting steps for the salt-transport process. In the conceptual processes for molten-salt fuel, U is first removed from the molten salt by volatility methods. The core salt is then distilled to separate the matrix salt, LiF_4–BeF_2, from the rare earth fluoride neutron poisons. (P.C.H.)

51064 PROGRESS IN RESEARCH AND DEVELOPMENT ON WASTE DISPOSAL. Fineman, Phillip. Reactor Fuel-Process. Technol., 11: 159-65(Summer 1968).

Calcination methods are discussed for the processing of aqueous plant wastes. The results of a laboratory study on the volatilization of Ru are described. Final disposal methods discussed include the use of salt mines for the storage of packaged solids from the processing of high-level-activity wastes. Some of the factors considered in the storage are the effects of radiation and heat, water release, stratigraphy of salt section in the vicinity of the demonstration site, and geological formations. The results of a heated pillar test are given. (P.C.H.)

51065 A SIMPLE METHOD OF REDUCING THE MOLYBDENUM CONTENT OF THE ELUATE FROM A ^{99}Mo–^{99m}Tc GENERATOR. Reese, Isaac C.; Mishkin, Fred S. (Indiana Univ., Indianapolis). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 896(Aug. 1968).

A simple method of reducing the ^{99}Mo content of a ^{99}Mo–^{99m}Tc generator was devised. It consists of passing the high ^{99}Mo content eluate through the generator used the previous week (provided the ^{99}Mo breakthrough of this generator was minimal), and then re-eluting the previous week's generator with saline for complete recovery of the ^{99}Tc. (auth)

51066 EXTRACTION OF ^{99}Mo FROM IRRADIATED SAMPLES OF LOWER–HIGHER OXIDES OF URANIUM. Shiryaeva, L. V.; Tolmachev, Yu. M. Radiokhimiya, 10: 439-45(1968). (In Russian).

During heating of neutron-irradiated uranium oxides with the composition $UO_{2.685}$ to $UO_{2.724}$, the extraction of ^{99}Mo occurs in two stages. The thermal decomposition of unirradiated samples of uranium oxide also occurs in two stages. The velocity of the first, very fast stage of ^{99}Mo extraction depends on many factors: method of preparation of the oxide, its composition, irradiation dose, and the medium in which the heating of the samples takes place. A determinative relation was noticed between the % extraction of ^{99}Mo and the degree of oxide decomposition. The first stage of extraction of ^{99}Mo, with significant decomposition of U_3O_{8+y}, corresponds to an activation energy at 45 to 55 kcal/mol. This value coincides with the magnitude of the activation energy for the thermal decomposition of U_3O_8 in vacuum. The velocity of the second, very slow stage is determined by the rate of the volume diffusion of ^{99}Mo in the hexagonal phase ($UO_{2.662}$ to $UO_{2.669}$) formed on heating and depends only on the heating temperature. The second stage of the ^{99}Mo extraction from uranium oxide, irradiated in an evacuated ampule, corresponds both to activation energy (22 to 26 kcal/mol) and to the extraction of ^{99}Mo from U_3O_{8+y} in an oxygen current (below 1000°C). At temperatures above 1000°C, because of the strong decomposition of all the oxides investigated, ^{99}Mo is extracted from them in large quantities (80 to 90%). (tr-auth)

51067 BEHAVIOR OF ^{210}Po IN PROCESSES OF DEACTIVATION OF FAULT WATER. BEHAVIOR OF ^{210}Po DURING COAGULATION WITH METAL HYDROXIDES. Pavlov-Verevkin, B. S.; Rauzen, F. V. Radiokhimiya, 10: 429-33(1968). (In Russian).

The mechanism of coprecipitation of ^{210}Po with coagulating metal hydroxides was investigated. It was shown that polonium hydroxide, occurring in the colloidal form, coagulates together with the hydroxides of the metal additions, and the residual concentration of Po in order of magnitudes corresponds to the solubility product of polonium hydroxide. In view of this, the coagulation of fault water, containing Po, can appear to be a means of eliminating Po; however, attempts to reduce its contents to MPC were unsuccessful. (tr-auth)

51068 EXTRACTION OF SCANDIUM ACETYLACETONATE IN PRESENCE OF DONOR-ACTIVE ADDITIVES. Shakhova, N. V.; Alimarin, I. P.; Zolotov, Yu. A. Radiokhimiya, 10: 467-70(1968). (In Russian).

The extraction of scandium acetylacetonate was investigated as a function of the pH, concentration of the reagent, nature of the solvent, and time of contact of the phases. The effect of TBP and TOPO (trioctylphosphine oxide) on the extraction was investigated. It was found that TOPO in contrast to TBP causes a synergetic effect. $Sc(AA)_2(ClO_4)$ (without TOPO) and $Sc(AA)(ClO_4)_2TOPO$ were probably extracted. (tr-auth)

51069 THIN-LAYER CHROMATOGRAPHIC SEPARATION OF SCANDIUM, RARE EARTHS, THORIUM, AND URANIUM.

Ishida, Koji; Ito, Takao; Kuroda, Rokuro (Univ., Chiba, Japan). Bunseki Kagaku, 17: 1122-3(Sept. 1968). (In Japanese).

Thin-layer chromatographic behavior of Sc, rare earths, Th, and U(VI) on a microcrystalline cellulose plate in n-butanol–nitric acid system was described. The R_f values of these metal ions were measured as functions of the concentration of nitric acid and of the volume ratios of the two phases. The best results for a separation of the four metal ions were obtained on the system consisting of n-butanol: 10N HNO_3 = 5:3, in which the R_f value was in the order, U > Th > Sc > Sm. The separation was achieved by raising the developing solvent 6.5 cm high within about 90 minutes. (auth)

51070 SEPARATION OF RARE EARTH ELEMENTS AND HAFNIUM BY COPRECIPITATION WITH FERRIC HYDROXIDE. Novikov, A. I.; Zakrevskaya, T. M.; Veselago, L. S. Radiokhimiya, 10: 485-7(1968). (In Russian).

The coprecipitation with ferric hydroxide of 20 μg Hf, 25 μg Tb, and carrier-free ^{143}Pr in solution with 1M NH_4NO_3 and 0.5M NH_4HCO_3 was studied over a wide pH interval. The coprecipitation of 50 mkg Lu in 1M solution of ammonium nitrate was studied. A method for the separation of small quantities of Hf and rare earth elements by coprecipitation of the carrier with ferric hydroxide in solution of ammonium bicarbonate in the pH interval from 8 to 9 was developed with the subsequent separation of the rare earth elements from the carrier by the reprecipitation of ferric hydroxide at a pH not above 3. (tr-auth)

51071 INVESTIGATION OF THE INTERACTION OF MICROQUANTITIES OF RADIOACTIVE ^{90}Sr IN AQUEOUS SOLUTION WITH GELATINE BY THE METHOD OF FOAM FORMATION. Pushkarev, V. V.; Berezyuk, V. G. Radiokhimiya, 10: 497-9 (1968). (In Russian).

The interaction of radioactive ^{90}Sr in aqueous solution with gelatine was investigated by extraction of surface-active material having the isotope in the chain. The interaction of gelatine with ^{90}Sr proceeds by the ion-exchange reaction of hydrogen of the surface-active material with $^{90}Sr^{2+}$. It was established that the dependence of the logarithm of the distribution of ^{90}Sr between the chain and the solution on the concentration of the cations of the salts LiCl, NaCl, KCl, $NaNO_3$, Na_2SO_4, $CaCl_2$, $SrCl_2$, and $BaCl_2$ was described by an equation derived as a result of the effective mass law. (tr-auth)

51072 EXTRACTION OF RADIOACTIVE ISOTOPES OF INDIUM FROM IRRADIATED TARGETS OF SILVER BY MEANS OF LANTHANUM HYDROXIDE. Plotnikov, V. I.; Gibova, E. G.; Kochetkov, V. L. Radiokhimiya, 10: 493-5(1968). (In Russian).

The coprecipitation of indium and silver by lanthanum hydroxide was investigated as a function of different factors. The possibility of the extraction of microquantities of indium from α-irradiated targets of silver was shown. (tr-auth)

51073 A $^{137}Cs-^{137m}Ba$ ISOTOPE GENERATOR. Pinajian, J. J. (Oak Ridge National Lab., Tenn.). J. Chem. Educ., 44: 212-13(Apr. 1967).

The 30-yr ^{137}Cs–2.6-min ^{137m}Ba pair was used to demonstrate the concept of the simple cow or generator system, where a relatively long-lived parent activity decays to a relatively short-lived radioactive daughter. The ^{137}Cs parent activity can be readily obtained as a fission product in 1M HCl solution and, at 50¢/Ci, is one of the least expensive of all radioisotopes. The general equations relating to the activities of radioactive parent-daughter systems are expressed mathematically. Zirconium phosphate was used as the exchanger, since Cs^+ is strongly held while Ba^{2+} is practically unadsorbed. A column was prepared from a disposable Pasteur-type pipet or a short length of 5-mm ID glass tubing drawn to a capillary tip. From 10 μCi to 1 mCi of ^{137}Cs stock solution was charged directly onto the column without any treatment. The column was allowed to run dry. Activity measurements on the eluate showed that >99.99% of the ^{137}Cs activity was adsorbed on the column. Elution was made by passing about 1 ml of 1M HCl through the column and collecting the individual drops in separate test tubes. The 661.6-keV photon was measured in a γ-spectrometric analyzer. By analyzing a 1.0-ml eluate 1 hr after elution (to reduce the ^{137m}Ba activity to a negligible level) and comparing this activity with the original activity at the time of elution, a limit of $<2 \times 10^{-5}$% was obtained for the ^{137}Cs contamination. The yield of ^{137m}Ba was ~20% of the theoretical value. (BBB)

51074 RAPID SEPARATION OF RADIOACTIVE NUCLIDES BY THE ELECTROLYTIC CHROMATOGRAPHY. Fujinaga, Taitiro; Izutsu, Kosuke; Koyama, Mutsuo; Okazaki, Satoshi; Tsuji, Kazuro (Kyoto Univ.). Nippon Kagaku Zasshi, 89: 673-6(July 1968). (In Japanese).

The rapid and continuous separation of radioactive nuclides was studied using electrolytic chromatography. The samples were mixtures of ^{212}Pb, ^{212}Bi, and ^{208}Tl with and without lead bismuth as carriers. The column of glassy carbon grains served as the working electrode, and the potential gradient was applied. The metal ions eluted were determined by means of γ-ray scintillation spectrometry. $^{212}Pb(Pb^{2+})$ and $^{212}Bi(Bi^{3+})$ could be quantitatively deposited from 0.5 N HCl solution: ^{212}Pb at the outlet part of the column electrode controlled at −0.7V vs Ag–AgCl electrode and ^{212}Bi at its inlet part at −0.4V. Under these experimental conditions ^{208}Tl passed through the column without being electrolyzed. Then, by proper switching of the potentials of the column electrode, ^{212}Pb and ^{212}Bi could be dissolved and eluted in this order. The separation was complete and quantitative within 10 min for ^{208}Tl, within 20 min. for ^{212}Pb, and within 30 min for ^{212}Bi. Separation of such a short-life nuclide as ^{208}Tl from other nuclides by electrolysis has never been reported. (auth)

51075 PREPARATION AND GAS CHROMATOGRAPHY OF COBALT(III) AND RUTHENIUM(III) FLUOROACETYLACETONATES. Veening, H.; Bachman, W. E.; Wilkinson, D. M. (Bucknell Univ., Lewisburg, Pa.). J. Gas Chromatogr., 5: 248-50 (1967).

The hexafluoroacetylacetonates of Ru and Co are separated on a borosilicate-glass column; Ar–methane is used as carrier gas, and the column is temperature-programmed from 30° to 100° at 7.9° per min. 1-Bromo-3-chloropropane is used as internal standard. The trifluoroacetylacetonates are separated on a similar column with the same carrier gas. The column is operated isothermally at 110°, and 2-bromonaphthalene is used as internal standard. Electron-capture detection is used in each instance. The retention values of the Ru and Co chelates and methods for their preparation are given. Quantitative results show that the analysis is more satisfactory for Ru than for Co. The trifluoroacetylacetonates of Co^{3+} and Cr^{3+} are not separated under the conditions described. (Anal. Abstr.)

51076 INFLUENCE OF THE FORM OF URANIUM OCCURRENCE IN SOLUTIONS ON ITS SORPTION BY NATURAL MINERAL FORMATIONS. Grabovnikov, V. A.; Samsonova, L. M. Geokhimiya, No. 10, 1250-8(Oct. 1968). (In Russian).

Results of an experimental study of the quantitative ratio between uranium content in solution in different forms and its capacity for being sorbed by the natural ground are stated. Synthetic solutions were investigated being analogous by their composition to natural waters with U^{6+} from 2.7×10^{-5} to 6×10^{-3} g/l, an ionic strength from 0.02 to 1 and a pH from 6.45 to 7.45. Results obtained were: (1) the investigated ground extracts uranium from solutions only present in a cationic form; (2) sorption of uranium in a cationic form obeys certain regularities known in physical chemistry (the Freundlich equation and others); and (3) the obtained data agree with the widely known conclusions about the high mobility of uranium in the hypergenesis zone where uranium prevailingly is present in the form of complex anions (carbonate uranyl complexes). (auth)

51077 BACTERIAL LEACHING. Pings, W. B. (Colorado School of Mines Research Foundation, Inc., Golden). Colo. Sch. Mines, Min. Ind. Bull., 11: 1-19(May 1968).

The value and process of bacterial leaching, as it is being used commercially for the recovery of U and Cu, either by leaching waste dumps or by in situ leaching in mines, is reviewed. An underground U leaching study employing Ferrobacillus ferroxidans, supplied with a nutrient solution containing ferrous sulfate, is described. The bacterial leaching program was initiated and carried out for a year in 100 mined-out stopes, using 2 methods of applying the washing solutions, a spray method and a high-pressure hose method. The bacterial activity resulted in a coating of basic ferric sulfate on most of the rocks. During the 1 yr period, 94 million gallons of water was treated for U recovery, yielding 127,000 pounds of U. The method of treatment involved partial neutralization by the injection of ammoniated water to the suction side of the 3000-ft-level pumps, reacidification at the mill to a pH of 2, and conventional ion exchange. Results showed that U can be recovered at a competitive cost by bacterial leaching in a closed-down mine. The use of bacterial nutrients was proved to be beneficial, the nutrient producing many times its worth in product. Bacterial action converted practically all of the soluble iron to the ferric state, which resulted in highly corrosive conditions. A temperature of at least 18°C is required to obtain good results. In 1964, the average cost of production of a pound of U_3O_8 had increased to more than $5, compared with $.65 for the 1962–1963 period. Bacterial leaching cut costs to $3.30 in the summer. The bacteria used must be grown under specific conditions to obtain a preferred strain that exhibits a satisfactory tolerance to U. Normally a tolerance to U between about 0.2 g/l and up to about 1 to 2 g/l of U_3O_8 is satisfactory since relatively dilute U solutions are encountered in practice, although tolerance to high concentrations of 20 to 25 g/l can be developed. (BBB)

51078 METHOD FOR SEPARATING ISOTOPES. Kakihana, Hidetake. Japanese Patent 1968-7518. Mar. 21, 1968. Filed Aug. 2, 1963.

A method is described for isotopic enrichment of all elements, except rare gases, by separation of isotopes in the form of ions. An electrodialysis cell is used in which cation-exchange membranes and anion-exchange membranes are arranged alternately. Compartments are thus formed between the cell cathode and the cell anode, and in each compartment the cation-exchange membrane is on the side of the cathode, and the anion-exchange membrane is on the side of the anode. In the respective compartments, the ions to be separated, pass through the membrane selectively, by flowing an electric current between the cathode and anode. By the repeated passages, the desired separation of the isotopes is achieved. (NSA of Japan)

51079 STUDY ON THE ELUTION OF RADIONUCLIDES FROM SOLIDIFIED WASTES. SOME THEORETICAL CONSIDERATIONS ON THE DIFFUSION IN POROUS MEDIA AND THE DETERMINATION OF EFFECTIVE DIFFUSION COEFFICIENTS. Iwai, Shigehisa (Kyoto Univ.); Terashima, Yutaka. Hoken Butsuri, 3: 261-72(June 1968). (In Japanese).

The rate of the elution of radionuclides from solidified wastes depends mainly on the dissolution at the surface of the solidified wastes and the diffusion process in the solidified body. Several methods to determine the effective diffusion coefficients were reviewed and developed in this study. The coefficients representing the diffusion of radionuclides migrating in the solidified wastes can be obtained through measurements of radionuclides leached from a solidified body, with limited or unlimited length, into a finite volume of water. (NSA of Japan)

51080 SOLVENT EXTRACTION OF NIOBIUM AND TANTALUM. VI. EXTRACTION WITH DI-N-OCTYLAMINO ALCOHOLS FROM HYDROFLUORIC ACID SOLUTIONS OF THE METALS. Djordjevic, C.; Sevdic, D. (Univ., Zagreb. Rudjer Boskovic Inst., Zagreb). J. Less-Common Metals, 16: 233-9 (1968).

Studies of the extraction of niobium and tantalum from hydrofluoric acid solutions, with di-n-octylaminoethanol (DOAE) and di-n-octylaminopropanol (DOAP), in chloroform, have been carried out. The metal/amine ratio was determined in the organic phase by the slope analysis. The extracting species of niobium and tantalum with DOAE were separated from the 0.04, 0.4, and 1 M HF systems, respectively. Different extracting species for niobium and tantalum were obtained, and characterized by analysis and infrared spectra. Species containing $NbOF_7^{3-}$ and $TaOF_7^{-}$ anions were separated from 0.04 M HF systems. (auth)

51081 PROCESS FOR SEPARATING STRONTIUM FROM FISSION PRODUCT SOLUTION BY FIXING ON ANTIMONIC ACID. Aubertin, Charles; Lefebvre, Jean; Galaud, Gerard; Prospert, Jacques (to Commissariat a l'Energie Atomique). U. S. Patent 3,399, 030. Aug. 27, 1968. Priority date Jan. 5, 1966, France.

An ion exchange process is described for separating Sr from complex solutions, especially for separating ^{90}Sr from acid solutions of fission products. The solution containing the Sr is contacted with an ion exchanger containing antimonic acid to adsorb the Sr, which is then eluted from the ion exchanger with a cation having a greater affinity for antimonic acid than Sr. An acidified solution of Ag or Pb is a suitable eluent. (B.L.M.)

51082 RECOVERY, IN AQUEOUS SOLUTION, OF NUCLEAR FUELS OF HIGH PLUTONIUM CONTENT. Baumgaertner, F. (Kernforschungszentrum, Karlsruhe, Ger.). Angew. Chem. Int. Ed. Engl., 6: 886(Oct. 1967).

In the simultaneous extraction of U and Pu during processing of fuel elements, the U strongly represses the extraction of Pu and critical concentrations of Pu can occur in the aqueous phase. In reductive separation of Pu and U, decontamination of the U is made difficult by the presence of large quantities of Pu; part of the Pu becomes irreversibly bound in the organic phase owing to radiolysis of the organic extracting medium. Measurements of the rate of material transfer for Pu and U indicated the possibility of a rapid extraction procedure and this was developed by means of a centrifugal separator, by use of which up to 120 kg of nuclear fuel can be worked up safely per hour. At the same time, disturbance of the extraction by radiolysis is reduced to $\sim 1/_{23}$. More than 99% separation of Pu from U is possible when U(IV) is used as reducing agent. (BBB)

51083 PROPOSED DEFINITION OF RADIOACTIVE WASTE CATEGORIES: A SUMMARY OF A USASI STANDARD. Blanco, R. E. Nucl. Safety, 9: 515-20(Nov.-Dec. 1968).

A method of classifying radioactive wastes, based on the maximum permissible concentrations (MPC) established by the International Commission on Radiological Protection (ICRP) has been accepted as a USA standard. Excerpts from proposed definition of radioactive waste categories are presented. (M.C.G.)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 50935, 51064, 51124, 51125, 51248, and 53431.

51084 (SZS-8/68) MEASUREMENT INSTRUCTIONS FOR DETERMINATION OF THE β ACTIVITY OF WATER, WASTES, SEDIMENTS, AND BIOLOGICAL SAMPLES FROM SURFACE WATERS. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Mar. 1968. 15p. (In German). Dep.

Specific instructions are given for the determination of the β activity of water, wastes, sediments, and biological samples from surface waters. The sampling procedures, preparation of the sample, determination of the gross activity, and correction of the measurement results by consideration of the potassium content of the sample are given in detail. A method is given for the flame photometric determination of K. (J.S.R.)

51085 STUDY OF TRACKS OF HEAVY IONS IN NATURAL MINERALS OF TERRESTRIAL AND EXTRATERRESTRIAL ORIGIN. **Maurette, Michel (Faculte des Sciences, Paris). Bull. Soc. Fr. Miner. Crist., 89: 41-79 (Jan.-Mar. 1966). (In French).**

The efficiency of registration of fission fragments in mica and makrofol is about 100%; in glass it is only 40%. Near the end of the trajectory of the ion there is a threshold of unitary loss of energy below which ions do not give determinable tracks. Therefore the Brinkman process can be eliminated for the formation of such tracks. At present there is no experiment showing clearly the existence of tracks formed by the "thermal point" mechanism. It is reasonable to anticipate finding different kinds of tracks. Tracks should be stable at ambient temperatures in micas for geological times greater than 5×10^8 years. Tracks have been found also in olivine. Dating of rocks from the tracks from ^{238}U does not always give the same age as other methods. Applications are made for meteoritic material; the preatmospheric masses of several pallasites are calculated. Suggestions for future study are made. (BBB)

51086 CARBON ISOTOPE COMPOSITION OF NATURAL METHANE OCCURRENCES. **Sackett, William M. (Texas A and M Univ., College Station). Contract AT(11-1)-1540. Amer. Ass. Petrol. Geol. Bull., 52: 853-7 (May 1968).**

Values of $\delta^{13}C$ for methane from individual producing gas wells and other occurrences are compiled. Some of the isotopically heaviest methanes, which are from hot spring gases, have a range of -10.4 to -28.4 per mil and it is believed that they had become isotopically equilibrated with heavy CO_2 at elevated temperatures. The isotopically light quaternary gases are, in general, marsh and glacial-till gases produced by bacterial processes. Differences in fractionation due to bacteria relative to chemical processes, or an isotopic fractionation during migration of methane, are not needed to explain the range and evolution of the isotopic composition of natural methanes. Rather, maturity, temperature at formation, and the strength of terminal carbon-carbon bonds in parent organic materials are the primary factors that determine the isotopic composition of all methane occurrences that have not become isotopically equilibrated with surrounding carbon-containing components. With a knowledge of these criteria, the carbon isotope composition of natural methane occurrences may yield valuable geological information such as the maturity of a gas, the temperature of a source rock at the time of formation of the methane, the time a reservoir was formed, and the time and direction of gas migration. (BBB)

51087 PROCEEDINGS OF THE THIRD ANNUAL AMERICAN WATER RESOURCES CONFERENCE, SAN FRANCISCO, CALIFORNIA, NOVEMBER 8-10, 1967. Francisco, Martha N. (ed.). Proceedings Series No. 3. Urbana, Ill., American Water Resources Association, 1967. 669p. (CONF-671118).

Sixty three papers were presented at the conference. One paper on the use of nuclear explosives in the development of water resources has previously appeared in NSA. For an abstract of this paper see 22: 8245. The remaining 62 papers are not in scope for NSA. (R.C.K.)

51088 LEAD- AND SULFUR-ISOTOPE RATIOS FROM THE GREAT SLAVE LAKE AREA, CANADA. Robertson, D. K.; Cumming, G. L. (Univ. of Alberta, Edmonton). Can. J. Earth Sci., 5: 1269-76 (Oct. 1968).

Lead- and sulfur-isotope ratios have been determined for some galenas and iron sulfides from two regions around Yellowknife, Northwest Territories. For the ore deposits, sulfur-isotope ratios are close to the meteoritic value or slightly positive. Lead-isotope ratios fall into two groups, one derived from a source with Th/U = 4.3 and μ = 9 to 11, and the other from a source with Th/U = 3.5 and μ = 9.0. The ratios fall on an anomalous lead line, which indicates one event of great antiquity (approximately 4000 million yr.), and another about 2800 million yr. ago. Other sulfide samples from areas around Great Slave Lake, primarily outside the ancient (2800 million yr.) Slave Province, indicate events at 2800 million yr. and 1550 million yr., the latter date probably representing the time of the last major tectonic event in the Slave Province. Sulfur-isotope ratios for these samples vary from +1‰ to −13‰ relative to the meteoritic value, suggesting that these leads may have been remobilized by thermal metamorphism, and recombined with crustal sulfur enriched in ^{32}S. (auth) (CANADA)

51089 SOME EFFECTS OF CONTACT METAMORPHISM ON ZIRCON AGES. **Davis, G. L.; Hart, S. R.; Tilton, G. R. (Carnegie Institution of Washington, D. C.). Earth Planet. Sci. Lett., 5: 27-34 (Sept. 1968).**

Zircons from Precambrian metasediments and granite adjacent to Tertiary intrusives show highly discordant U−Pb ages, with the degree of discordance directly related to distance from the intrusive contact. The discordant ages define 1615 to 60 and 1430 to 60 million year chords on a concordia diagram. As the contact is approached uranium and thorium contents of the zircons increase, radiogenic lead content decreases, and the zircons become progressively more euhedral. This episodic discordance may be explained on the basis of crystallization, recrystallization, or episodic diffusion models, or a combination of these. (auth)

51090 ARGON-40: EXCESS IN SUBMARINE PILLOW BASALTS FROM KILAUEA VOLCANO, HAWAII. Dalrymple, G. Brent; Moore, James G. (Geological Survey, Menlo Park, Calif.). Science, 161: 1132-5 (Sept. 13, 1968).

Submarine pillow basalts from Kilauea Volcano contain excess radiogenic argon-40 and give anomalously high potassium-argon ages. Glassy rims of pillows show a systematic increase in radiogenic argon-40 with depth, and a pillow from a depth of 2590 meters shows a decrease in radiogenic argon-40 inward from the pillow rim. The data indicate that the amount of excess radiogenic argon-40 is a direct function of both hydrostatic pressure and rate of cooling, and that many submarine basalts are not suitable for potassium-argon dating. (auth)

51091 YADERNAYA GEOFIZIKA. (Nuclear Geophysics). Alekseev, F. A. (ed.). Moscow, Izdatel'stvo Nedra, 1968. 288p.

Thirty articles are presented which relate to the application of radioactive methods in prospecting, exploration, and development of profitable mineral resources. Topics include the use of isotopes and radiation sources in hydrology, geochemistry of radioactive elements, use of pulse neutron-neutron techniques in locating petroleum and gas deposits and development of apparatus and methods for oxygen sources. (tr-auth)

Meteorology

Refer also to abstracts 51131 and 51570.

51092 (CTC-1) PROPERTIES OF ESTIMATORS FOR THE GAMMA DISTRIBUTION. Bowman, K. O.; Shenton, L. R. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Sept. 27, 1968. Contract W-7405-eng-26. 50p. Dep. CFSTI.

The gamma distribution $f(x) = (x/a)^{\rho-1}(\exp - (x/a))/a\Gamma(\rho)$ is widely used in statistical application, such as life testing procedures, and especially recently in connection with cloud seeding and other weather modification experiments. The maximum likelihood estimators $(\hat{a},\hat{\rho})$ are known to be sufficient estimators, but little, apart from asymptotic normality, is known about their distributional properties in finite samples. Expressions for the first four moments of $\hat{a}$ and $\hat{\rho}$, as far as terms of order n^{-2}, the sample size being n have been derived. In particular, exact expressions are given for the n^{-1} terms in the biases of $\hat{a}$ and $\hat{\rho}$, and for the n^{-2} terms in the covariances. It is indicated how deficient the first order asymptotics are (first order referring to the dominant term), and how quickly asymptotic normality is reached. Exact expressions for the first four moments of the moment estimator of a, and comment on the moment estimator of ρ are given. The results have been verified, as far as this is feasible, through Monte-Carlo simulations, and where possible through alternative algebraic approaches. (auth)

51093 (FFR-401/68) MEASUREMENTS OF FISSION PRODUCT ACTIVITY IN AIR AND IN PRECIPITATION UP TO 31 DE-

CEMBER 1967. Report No. 28. (Forsvarets Forskningsrad, Copenhagen (Denmark)). May 1968. 13p. Dep.

Air and precipitation samples were collected in Denmark, the Faroes and Greenland and measured for total activity, ^{90}Sr, ^{137}Cs, and Zr/Nb-95. The mean value of ^{90}Sr in air from Copenhagen was 1 pCi/1000 m^3. The Chinese test on June 17, 1967 was detected in ground-level air in Copenhagen at the beginning of August 1967. ^{140}Ba and ^{131}I originating from the Chinese test on December 24, 1967 were detected in air samples from January 2 to 3, 1968. (auth)

51094 (FOA-4-4369) DEBRIS FROM CHINA'S SIXTH NUCLEAR TEST. Persson, G.; Sisefsky, J. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Aug. 1968. 11p. Dep.

Nuclear debris from China's sixth nuclear bomb test was not found in Sweden until two months after the explosion. The particles are colourless-orange-dark red and have a uniquely high specific activity—up to about 100 dpm $\beta\mu m^3$ at 100 days age, a factor 15 higher than for the 3rd Chinese test. Gammaspectrographic data are given. They confirm the age of the debris by the $^{95}Zr/^{95}Nb$ ratio. Factors, which may have caused the unusual fallout picture are discussed. It is tentatively concluded that the explosion occurred below 14 km altitude after which the fire ball rose to the vicinity of 20 km altitude. (Sweden)

51095 (NDL-SP-16) THE MECHANISMS OF FALLOUT PARTICLE FORMATION. Annual Progress Report for Period Ending March 1967. Bloore, Ernest W.; Benck, Ralph F.; DeTuerk, John J. Jr.; Yannopoulos, L. N.; Hill, Charles G. Jr.; Kokalas, Joseph J.; Houseman, Barton L.; Walker, Lewis A. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Apr. 1967. Contract AT(49-7)-2883. 79p. Dep. CFSTI.

The high-temperature properties of gaseous fission products and the phenomenon of gaseous fission products colliding with gaseous, liquid, or solid materials are discussed. Discussion and studies include: sticking phenomena, sticking coefficient measurements, gaseous species, and high-temperature effects on kaolin and SiO_2. (auth)

51096 (NSJ-tr-116) EVALUATING METHOD FOR GROUND SURFACE CONTAMINATION DURING RAIN. Kakuta, Michio. Translated from Nippon Genshiryoku Gakkaishi, 9: 186-91(Apr. 1967). 17p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 28105.

51097 (PINSTECH/HP-3) DETECTION AND MEASUREMENT OF FALLOUT RADIOACTIVITY AT PINSTECH. Aziz, Abdul; Mubarak, M. A. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Health Physics Div.). Mar. 1968. 15p. Dep.

The detection and measurement of fallout radioactivity in air was started at Pinstech in May, 1966 following a Chinese nuclear explosion on May 9, 1966. Samples of airborne dust were collected by passing the air through filter papers, which were then analyzed for the detection and identification of fission products by means of a sodium iodide scintillation detector used with a multichannel analyzer. It was possible to identify and measure fresh fission products originating from the Chinese nuclear explosions. The transport of fission products from a nuclear explosion, experimental methods used for the collection and the analyses of the samples, and the results obtained at this Institute are discussed. (auth)

51098 EXPERIMENTAL SYSTEM FOR AEROSOL RESEARCH. Haughey, Francis J.; Manganelli, Raymond M. (Rutgers-The State Univ., New Brunswick, N. J.). Amer. Ind. Hyg. Ass. J., 29: 268-78(May-June 1968).

An aerosol test system which permits the study of interactions between aerosol particles, carrier gas, and various pollutants, including radioactive atoms and ions, is described. The system includes aerosol generator, contact and retention chambers, scattered light sensor units and multichannel analyzer, and cascade impactors. Aerosol flow is controlled by means of solenoid valves. Readout of particle data from the multichannel analyzer is by typewriter, recorder, and punched paper tape for input to an IBM 1620 or 7040 computer for calculation of particle distribution parameters. The flexibility of the system has been shown in studies involving carbon, titanium dioxide, and fly-ash particles in nitrogen, argon, and argon plus water vapor carrier gases and the daughters of radon-220. (auth)

51099 MEASUREMENT OF ALPHA RADIOACTIVE AIRBORNE DUST COLLECTED ON CELLULOSE ASBESTOS FILTER PAPER. α RAY SPECTROMETRY AND INFILTRATION OF RADIOACTIVE DUST INTO A FILTER PAPER. Kuroda, Hayao (Japan Atomic Energy Research Inst., Tokyo). Hoken Butsuri, 3: 280-7(June 1968). (In Japanese).

In measuring α ray spectra of radioactive airborne dust collected on a filter paper, the presence of α emitters to be detected is masked out by Rn and Tn daughters in the atmosphere. Contributions of Tn daughters to α ray spectra of airborne radioactive materials were evaluated for two types of cellulose asbestos filter paper, HE-40 (Toyo) and HV-70 (Holling Worth & Vose), employed in routine air sampling, using the TMC 1024 pulse height analyzer with a silicon semiconductor detector. The distribution was also examined by α counting of thin stripped fragments of the filter paper, and was found to be exponential. On the basis of the results obtained, the collection efficiency of HE-40 and the absorption of α particle in the filter paper are discussed. (NSA of Japan)

51100 INVESTIGATION OF ELECTRICAL CARRIERS OF NATURAL ATMOSPHERIC RADIOACTIVITY. Styro, B. I.; Pestov, V. S. (Inst. of Physics and Mathematics, Vilnyus, USSR). Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 4: 850-7(Aug. 1968). (In Russian).

Investigation of positive and negative radioactive ions as well as neutral carriers of radioactivity was carried out by means of a three-staged electric aspirator. Carriers of Rn and Tn decay products were studied in clear weather conditions at night at four altitudes (0.01; 0.5; 2.5; 12.5 m). Nuclear emulsions served as detectors of radioactivity. It was found that the number of light positive ions decreases with the increase of altitude while light negative ions are absent. Near the ground the radioactivity carried by positive ions is three times more than that of negative ions but at an altitude of 12.5 m they are equal. Most of the natural radioactivity of the atmosphere accumulates on neutral aerosols. Neutral aerosols, medium-weight, and heavy ions are Tn radioactivity carriers. An attempt was made to explain the absence of light negative radioactive ions by different mechanisms of origin of light, middle-weight and heavy radioactive ions. The time of life of light radioactive ions was calculated and is shown to decrease to 5 to 2.5 sec with the increase of altitude. (auth)

51101 RADIOACTIVE NUCLIDES IN ATMOSPHERE AND SOIL AIR NEAR THE GROUND SURFACE. Yamashita, Tairi; Momoi, Tsuneo (Kumamoto Univ., Japan). Kumamoto Daigaku Kyoikugakubu Kiyo, No. 16, 3-10(Feb. 1968). (In Japanese).

The investigation of diurnal variation of the amount of radioactive nuclides in the atmosphere near the ground, and the spectral analysis of the nuclides produced by the radioactive gas escaping from the soil were carried out. The diurnal variation was closely related to the variation of meteorological variables. Decay products of radon and thoron in soil air were identified by spectral analysis. (NSA of Japan)

51102 ATMOSPHERIC OZONE AND RADIOACTIVE FALLOUT. Miyake, Yasuo; Kanazawa, Teruko (Meteorological Research Inst., Tokyo). Pap. Meteorol. Geophys. (Tokyo), 18: 311-26(Dec. 1967).

The seasonal variations of atmospheric ozone and ^{90}Sr fallout were compared at various stations in Canada, India, Japan, UK and USA. The results showed that, in the ozone variation, 17 out of 43 peaks were observed in March and 11 in April, while the troughs were observed mostly in October and November. For ^{90}Sr fallout most of the maxima appeared in April and May and the minima from August to October. It is pointed out that rates of out-flow of ozone and radioactive debris from the stratosphere should be proportional, the rapid removal with seasonal variation must be taken into account in studying the ozone budget in the stratosphere. (NSA of Japan)

51103 DETERMINATION OF RATIOS OF CONCENTRATIONS OF THE RADIOISOTOPES ^{144}Ce AND ^{137}Cs IN ATMOSPHERIC DEBRIS COLLECTED IN BUCHAREST DURING THE WINTER, 1964 TO 1966. III. Voljin, V.; Ciudin, T. (Univ., Bucharest). Stud. Cercet. Fiz., 20: 93-100(1968). (In Rumanian).

By the use of the γ-spectrometric method and of some results of radiochemical analysis, the presence of the radionuclides ^{137}Cs, ^{144}Ce, $^{95}Zr(^{95}Nb)$, and $^{106}Ru(^{106}Rh)$ was identified in the atmospheric debris collected in Bucharest during the winters 1964 to 1966. The results are compared with those obtained in the period 1962 to 1964. It was deduced that actually the general level of the radioactivity showed a slight decrease, but the presence of the radionuclides $^{95}Zr(^{95}Nb)$ and $^{106}Ru(^{106}Rh)$ was more marked. The variation of the ratio of the radionuclides ^{144}Ce and ^{137}Cs was appreciable; it was attributed to certain meteorological phenomena. (tr-auth)

51104 EVALUATION OF γ-RADIATION ATTENUATION BY SNOW COVER. Pavlov, V. V.; Konstantinov, I. E.; Fedorov, G. A. At. Energ. (USSR), 25: 66-7(July, 1968). (In Russian).

Gamma radiation attenuation by snow cover was calculated using mean data on precipitation and thawing collected in Moscow and Murman districts. Calculations were made assuming that the sources of γ quanta are distributed in the ground according to the

exponential law and in the snow homogeneously. The doses from these sources were calculated separately. The variations of γ doses from ^{137}Cs showed that snow mantle had a prevailing effect on radiation attenuation. (R.V.J.)

51105 ON BEHAVIOR OF Ra DAUGHTER PRODUCTS IN AIR. Ermilov, A. P.; Klinov, V. V.; Labushkin, V. G. At. Energ. (USSR), 25: 61-2(July 1968). (In Russian).

Scintillation and semiconductor α spectrometry methods were used for measuring the transmission of RaA recoil atoms in the air in respect to the distance from the source of their generation. The graphs of the transfer coefficient of RaA recoil atoms in the air at measured distances from 0 to 4 mm and the spectrum of α emission of the radon daughter products measured by α spectrometer Amur-1 are included. (R.V.J.)

51106 WALL INFLUENCE ON FREE RaA AND RaB ATOM DISTRIBUTION IN A CLOSED VOLUME OF AIR. Ermilov, A. P.; Klinov, V. V.; Labushkin, V. G. At. Energ. (USSR), 25: 60-1(July 1968). (In Russian).

Distribution of free atom concentration of RaA and RaB radon daughter products was calculated considering the distance of the flat walls and the spherical radius. In both cases it was assumed that the air was dust free. The probability of RaA and RaB atom capture by walls was equal to unity, the concentration of ^{222}Rn was considered constant in all points and at all time, and the diffusion coefficients of ^{222}Rn and free atoms of RaA and RaB are identical. (R.V.J.)

Mineralogy and Exploration

Refer also to abstract 53506.

51107 (NIM-44) ZERO POINT OF CHARGE OF URANIUM DIOXIDE AND URANINITE. Carlton, Claire J. E.; Laxen, P. A. (National Inst. for Metallurgy, Johannesburg (South Africa)). June 27, 1966. 11p. Dep.

The zero point of charge (z.p.c.) of a mineral in contact with a solution occurs when the positive and negative charges on the solid surface are equal. For oxides, the value of the z.p.c. is the pH of the solution in which the mineral surface has no net charge. This is a useful parameter in studies of flotation and dissolution. The z.p.c.s of UO_2 and uraninite were determined by potentiometric titrations. The values obtained were 4.8 and 6.6, respectively. (auth)

51108 PROCEEDINGS [OF] CONFERENCE ON NUCLEAR FUEL EXPLORATION TO POWER REACTORS, OKLAHOMA CITY, OKLAHOMA, MAY 23-24, 1968. Atlanta, Southern Interstate Nuclear Board, 1968. 217p. $5.00. (CONF-680528).

The proceedings of the May 1968 conference on nuclear fuels held at Oklahoma City are presented. Seventeen papers were presented on all phases of nuclear fuels including the prospecting and mining of uranium ores, uranium processing, nuclear fuel procurement and management, and the economics of each phase. (L.C.L.)

51109 ISOTOPIC COMPOSITION OF LEAD AND CONCENTRATIONS OF URANIUM, THORIUM, AND LEAD IN VOLCANIC ROCKS FROM DOGO OF THE OKI ISLANDS, JAPAN. Kurasawa, Hajime (Geological Survey of Japan). Geochem. J. (Nagoya), 2: No. 1, 11-28(Mar. 1968).

The isotopic composition of lead and the abundances of lead, uranium, and thorium in alkali rocks from Dogo of the Oki Islands, and Taka-shima, West Japan, have been determined. The lead, uranium and thorium contents range from 2.4 to 21.7 ppM, 0.4 to 3.6 ppM, and 2.6 to 27.1 ppM, respectively. They show a slight increase with progress in magmatic differentiation and a large increase from trachyte to rhyolite. A range of μ_0 ($^{238}U/^{204}Pb$) = 8.6 to 8.7 is calculated for a primary growth curve from the leads of Dogo. The observed μ ($^{238}U/^{204}Pb$) values of the rocks fall in a range 8.4 to 13.5. The observed κ ($^{232}Th/^{238}U$) values are in a range 4.8 to 9.8. The observed μ and κ for the rocks of Dogo are higher than for tholeiites and high-alumina basalts in Japan. The rocks from Dogo are relatively deficient in ^{206}Pb compared with the calculated model, suggesting that at least some lead was derived from a source of low μ during the last 2 to 3 billion yr. Consequently these volcanic rocks show isochron model ages of around 0 to 500 million yr, which are older than the known age of the rocks. In addition, olivine basalts are isotopically uniform and more radiogenic in $^{206}Pb/^{204}Pb$ than the trachybasalt and the alkali series differentiates. Either the trachybasalts were generated from a source different from the rest of the volcanic rocks or, if all the volcanic rocks were generated from a single source, they subsequently acquired some leads isotopically different from those of the source. Natural contamination can explain the peculiar results in the islands, where partial assimilation of pre-Tertiary basement rocks, probably Precambrian rocks resulted in the less radiogenic lead isotope ratios in the differentiates from the islands. (NSA of Japan)

51110 URANIUM MINING AND ITS EXPANDING MARKET. Faulkner, Rafford L. (Atomic Energy Commission, Washington, D. C.). S. Afr. Mining Eng. J., 79: 430-6(Feb. 23, 1968).

Nuclear power growth estimates have required substantial upward revision recently to keep pace with the growing volume of nuclear power plant orders. AEC uranium procurement, now reduced to a level of about 8000 tons U_3O_8/yr, is scheduled to terminate at the end of 1970; the AEC may accumulate an inventory in excess of its projected needs. There may be 40,000 to 50,000 tons available for commercial use. There has been a steady increase in projected needs of cumulative U requirements since 1962 to the present cumulative estimate of 250,000 tons U_3O_8 through 1980 for the U.S.A. alone. World requirements will total 500,000 tons. Not all of the U in the known reserves could be produced by 1980. The production situation in South Africa and Canada is noted. The introduction of breeder reactors in the early 1980's apparently will not immediately decrease U requirements. The effect might be a small increase in requirements for a few years because Pu, which might otherwise be recycled and used to fuel existing reactors, would be earmarked as fuel for the breeders. Most observers expect that it will be necessary to build light-water reactors or advanced converters for an extended period, in order to meet electricity production growth rates and at the same time produce sufficient Pu for a true breeder economy. Studies indicate that U requirements will probably continue to increase through the year 2000, though the rate of increase may slow toward the end of the century. (BBB)

51111 URANIUM RESOURCES AND URANIUM PRODUCTION OF THE CAPITALIST COUNTRIES. Gavrilov, I. D. Z. Angew. Geol., 12: 158-60(Mar. 1966). (In German).

Production and resources in 1962 and preceding years are tabulated for the USA, Canada, South Africa, Australia, France, Congo, Malagasy Republic, Italy, and India. Purchases of U by the Atomic Energy Commission (USA) from 1943 to 1962 within the USA, from Canada, and from other countries and mean costs per ton U for each year between 1950 and 1962 are tabulated. Search for new deposits has continued; the large mining districts were well known before the advent of modern technology because of the interest in Ra obtained from them in earlier years. Methods of exploration for deposits are described, including individual prospecting and the more successful public and private coordinated geological investigations. Diminution of U concentrate production after 1959 was due to reduction in purchases by the AEC. The drop in purchases resulted from stockpiling by the AEC and the desire to force a drop in prices. From 1963 to 1970 production in the western world is planned as 122,000 tons; in the following countries, production should reach these figures: USA, 65,450 tons; Canada 21,350 tons; South Africa 17,000 tons; France 13,600 tons; Australia 2,700 tons; others 1,800 tons. The AEC is assumed to use all USA production and 50% of Canadian and South African, bringing its total U from 1943 to 1970 to 272,000 to 273,000 tons. The further reduction in U production in this period is prescribed by the monopoly in the U industry in the USA. (BBB)

51112 INFLUENCE OF REDUCTIVE PROPERTIES OF ROCKS ON THE LOCALIZATION OF THE HYDROTHERMAL URANIC MINERALIZATION. Evseeva, L. S.; Fomina, N. P.; Ordynets, G. E. At. Energ. (USSR), 25: 200-9(Sept. 1968). (In Russian).

Results of experimental investigations of reductive properties of the rocks, ores and minerals on U endogenous deposits in crystalline shields are given. It is shown, that these properties may be used as one of the criteria in the estimation of radioactive deposits. (auth)

51113 RECOVERY OF URANINITE FROM RAKHA COPPER MINES. Degaleesan, S. N.; Karve, V. M.; Viswanathan, K. V.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: No. 1, 42-4(Mar. 1968).

Copper ore from the Rakha Mines of Bihar contains 0.02% U_3O_8, a small part of which goes into the sulfide concentrate. Attempts have been made to recover the uranium values from the flotation tailings. By wet tabling, followed by magnetic separation of magnetite, the concentrate assayed 1.65% U_3O_8 the recovery being 54.0%. By a new combination of reagents including iso-octyl acid phosphate and conditioning the pulp at a high pulp density, followed by the addition of sulfuric acid to maintain a pH of 1.5, a concentrate was obtained assaying 0.15% U_3O_8, the recovery being 88%. (auth)

51114 URANIUM DEPOSITS IN THE WESTERN PART OF YAMAGUCHI PREFECTURE, JAPAN. Hayashi, Shoichiro.

Nippon Genshiryoku Gakkasishi, 10: 444-8(Aug. 1968). (In Japanese).

A weak radioactive anomaly (0.080 mR/hr) was detected at Yuya in 1959, but since then no further efforts in prospecting have been undertaken in the area. In November, 1966, significant radioactivity (1.7 mR/hr, 0.6% U_3O_8) was detected 35 m south of the previous location, in the course of a systematic carborne radiometric survey. To date, several uranium occurrences have been discovered in formations belonging to the Cretaceous Period. This is the first instance of such occurrence in Cretaceous formation discovered in Japan. The Yuya uranium deposits occur mainly in dark gray to brown, hard compact sandstone and/or sandy shale. The deposits appear related to rhyolitic rock intrusions. A secondary uranium mineral, believed to be autunite, is sporadically found in the black silicified sandstone closely associated with pyrite and chlorite. Little uranium would appear to be contained in such clay minerals as chlorite according to radioluxograph and x-ray fluorescent examination, since primary uranium minerals have not been identified. So far prospecting for uranium deposits in Japan has been directed mostly to the Neogene Tertiary just above the granitic host rocks. The discovery of the Yuya deposits in Cretaceous formation is highly significant in that it has opened up a vast new area to prospecting in strata other than Tertiary formation. (auth)

51115 DEVELOPMENT OF URANIUM RESOURCES IN JAPAN. Kamiyama, Teiji (Power Reactor and Nuclear Fuel Development Corp., Japan). Genshiryoku Chosa Jiho, No. 14, 1-20(Dec. 1967). (In Japanese).

Japanese uranium reserves are discussed. The Ningyo-toge mine has deposits of about 5,000,000 tons, with average concentration 0.05%, 20% of the total being about 0.1%. The development of uranium resources in Japan is described in the following: prospecting expenditures and secured deposits; the prospecting of uranium resources in Japan; mining; refining; safety; and uranium prospecting in oversea countries. (NSA of Japan)

51116 CRYSTALLOGRAPHIC STUDY OF CUPROSKLODOWSKITE. Bariand, P.; Le Bihan, M. Th.; Gillet, Y. (Univ., Paris). Bull. Soc. Fr. Miner. Crist., 90: 259(Apr.-June 1967). (In French).

Cuprosklodowskite has the chemical composition $CuO \cdot 2UO_3 \cdot 2SiO_2 \cdot 6H_2O$. Recently, exceptional specimens were discovered in the cuprocobaltiferous deposits at Musonoi, Katanga. The crystals are emerald-green needles, ellongated along the 001 plane to a length of 2 cm. A cleavage parallel to the 100 plane is found. Twinning by rotation around the 001 plane is frequent. A powder pattern was taken and primary lines recorded. The mineral is triclinic; the parameters were determined from rotating crystal and Weissenberg diagrams and found to be as follows: a = 9.21; b = 6.63; c = 7.06 A ± 0 02; $\alpha = 90°$; $\beta = 110°$; $\gamma = 108°30' \pm 20'$; V = 381 $Å^3$; $d_{calc} = 3.83$; Z = 1. The hydrostatic density is 3.85 ± 0.02. The atomic structure determination is in progress. (BBB)

51117 GAMMA-SPECTROMETRIC METHOD IN GEOLOGICAL MAPPING AND ORE PROSPECTING. Smirnov, G. S.; Kornilov, F. M.; Tikhomirov, N. D.; Vetrov, A. G. pp 235-42 of Geologicheskie Rezul'taty Prikladnoi Geofiziki. Moscow, Izdatel'stvo Nauka, 1968. (In Russian).

Relations between radioactive elements (Th/U, U/K) and gamma radiation of some radioactive elements have been used for studying the geological structure of promising ore zones. Estimation of the observed anomalies is given on the basis of correlations between radioactive elements and nonradioactive ores. Instruments carried by hand or mounted in vehicles and airplanes have been used for rapid determination of the content of radioactive elements in the rocks by means of gamma spectrometric measurements. Some examples of the results that can be obtained from gamma spectrometric investigations are: interpretation of records of the radioactive elements content and correlation with rare earth ore zones; interpretation of airborne data for determination of phosphorite-bearing layers and combustible shales with localization of ore areas; differentiation of magnetic anomalies which may indicate diamonds or diamond-bearing rocks; determination of mineralized zones and secondary haloes of dispersion of uranium (radium) under complex geological conditions, and mapping of alcaline intrusives promising for rare earths and other ores by measuring potassium content. Recommendations are given for improvement of gamma-spectrometry techniques and their combination with other geophysical methods in reconnaissance searches during surface geological mapping. (auth)

51118 SOME INVESTIGATIONS ON THE MINERAL COMPONENTS OF THE URANIFEROUS BED EXPOSED IN THE OGUNI-KANAMARU DISTRICT ON THE BORDER OF YAMAGATA AND NIIGATA PREFECTURES. I. HEAVY MINERAL COMPOSITIONS OF THE CORE SAMPLES AT KOETO. Aoki, Kazuko (Yamagata Univ., Japan). Yamagata Daigaku Kiyo, Shizenkagaku, 7: 57-76(Jan. 1968). (In Japanese).

Neogene sediments are widely exposed in the Oguni-Kanamaru area which is situated on the border of Yamagata and Niigata Prefectures. Recently, uraniferous deposits of sedimentary type have been found in the basal part of the Tsugawa Formation belonging to the Neogene sediments in this area. The uraniferous beds exposed in this area have been investigated for mineral ingredients, with special reference to the heavy mineral components of the core samples from Koeto. Analyses carried out for 18 specimens to examine the heavy mineral components in the core samples at Koeto revealed that they contain tuffaceous sandstone, arkose sandstone, and granitic rock. The minerals determined in this way are zircon (A), biotite, muscovite, garnet, green hornblende, zircon (B), tourmaline, rutile, anatase, epidote and pyrite. The composition of heavy minerals, their modes of occurrence, sources and the relationship to lithological characteristics and uranium deposits were explained. The heavy mineral composition of the core samples found at Koeto seems to be useful for the determination of the sedimentary environment of the uraniferous bed in this area, and also useful for the consideration on the origin of uranium of the deposits. (NSA of Japan)

51119 APPLICATION OF MATHEMATICAL METHODS TO PROSPECTING FOR URANIUM. Balasanov, G. N.; Surazhskii, D. Ya.; Chumachenko, B. A.; Deryagin, A. A.; Vlasov, E. P. At. Energ. (USSR), 25: 274-80(Apr. 1968). (In Russian).

Mathematical treatment of results of prospecting and exploring latent or overlapping, hydrothermal uranium deposits are reported. It is shown that both pattern recognition and multivariate statistical analysis may be used for constructing mathematical models describing the relationships between the geologic-geochemical characteristics in the points observed and the position of these points in the ore fields. Such models may be used for direct exploration for uranium ore, estimation of the extension of the ore bodies in the vertical direction, valuation of the ore reserves based on singular wells and outcrops, and determination of the informative power as related to different geologic-geochemical data. A listing of 15 references is included. (tr-auth)

Oceanography

51120 (NYO-3109-35) A NEW SET OF OCEANIC DIFFUSION DIAGRAMS. Technical Report No. 38. Okubo, Akira (Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). June 1968. Contracts AT(30-1)-3109; Nonr 4010(11). 52p. Dep. CFSTI.

Some empirical relations between diffusion characteristics are investigated by the use of carefully examined data from dye release experiments in the surface layer of the sea. These data cover a time scale of diffusion ranging from 1 hour to 1 month and a length scale from 100 m to 100 km. Two "oceanic diffusion diagrams" are prepared; one showing horizontal variance versus diffusion time and the other showing apparent diffusivity versus the scale of diffusion. The overall behaviors of the horizontal variance and of the apparent diffusivity are evidently different from those which the similarity theory of turbulence deduces. However, there still remains a possibility that the similarity theory may be valid locally in time- or length-scale with a variable parameter, i.e., the rate of turbulent energy transfer. The diagrams provide a practical means to predict the rate of horizontal spread of substance introduced from an instantaneous point-source as well as the apparent diffusivity as a function of the size of diffusing patch. (auth)

51121 RADIOACTIVE WASTE DISPOSAL OPERATION INTO THE ATLANTIC, 1967. Paris, European Nuclear Energy Agency, 1968. 74p.

The deep-sea disposal of solid radioactive wastes raises international administrative and political, as well as scientific, technological, and economic questions. To deal with these and to establish, on an international basis, the required operational controls for sea disposal of packaged solid wastes, an experimental international operation was carried out in the summer of 1967 under the European Nuclear Energy Agency (ENEA). Five member countries of ENEA took part, and some 11,000 tons of solid waste, with a total activity of approximately 8,000 Ci, were deposited at a depth of 5000 m in the eastern Atlantic Ocean. The planning and execution of the operation are described in detail. The experiment successfully demonstrated that solid radioactive wastes can be safely disposed of at sea without damage to the marine environment, and that international cooperation in such an operation is mutually beneficial to the participating countries. (L.C.L.)

51122 RADIOAKTIVNOST' OKEANOV I MOREI. (Radioactivity of Oceans and Seas). Shvedov, V. P.; Patin, S. A. Moscow, Atomizdat, 1968. 287p.

The basic aspects of the investigation of the radioactivity of the oceans of the world were examined in connection with the use of natural and artificial radioisotopes as indicators of the natural oceanic processes. On the basis of published data a survey was made of the content of natural radioelements in the biosphere. The course and migration forms of uranium and thorium in the oceans, the distribution and forms of occurrence in seawater and ground sediment of the basic members of the radioactive series, and the behavior of cosmogenic radioisotopes and elements not in the uranium and thorium series were analyzed. The appearance in the seas of a new ecological factor—artificial radioactivity—was caused by tests of nuclear weapons or by deposition of wastes from atomic installations. The behavior of the artificial radioisotopes in the sea, and their distribution and migration are analyzed. Some regularities of the development of the radioactive contamination are described. Some possible uses of radioactive indicators in the areas of physical oceanography, the chemistry of oceans, and geochemistry of the segregation of elements are discussed. (tr-auth)

51123 SAND MOVEMENTS ON THE COAST AND THEIR DETERMINATION BY RADIOISOTOPES. Petersen, Marcus (Amt fuer Wasserwirtschaft, Kiel). Naturwissenschaften, 55: 328-32(July 1968). (In German).

The usual methods for the measurement of sand movements are compared with the radioisotopic methods. The radioisotopes commonly used in these measurements are tabulated. The experimental studies and the experimental apparatus used in the investigation of the sand movements on the east coast are outlined. The results showed the validity of the use of radioisotopic methods. The radioisotope method was compared with the luminophor method. (J.S.R.)

Seismology

Refer to abstract 51274.

ENGINEERING

Nuclear Explosions

51124 (PNE–905) PRESHOT GEOLOGIC AND ENGINEERING PROPERTIES INVESTIGATIONS. Project PALANQUIN. Nugent, Robert C.; Girucky, Frank E. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). June 1967. 70p. Dep. CFSTI.

A comprehensive geologic and engineering investigation was undertaken at the site on Pahute Mesa selected for the Palanquin event, a cratering experiment conducted in dry rock at the U. S. Atomic Energy Commission's Nevada Test Site. Foundation conditions were determined by means of five borings satellitic to the emplacement hole: The site is blanketed by a thin soil cover ranging in thickness from 4 to 13 feet, overlying a 575-foot-thick section of the Ribbon Cliff formation. The uppermost flow of this formation is porphyritic trachyte, which is at least 351 feet thick beneath the site. The Ribbon Cliff formation is immediately underlain by the vitric tuffs and welded tuffs of the Timber Mountain Tuff. Subsurface data indicate the presence of a high-angle normal fault that strikes N27°E and dips 64 degrees to the northwest. This fault plane is enveloped by a zone of intense fracturing that is 73 feet thick. The base of this fracture zone parallels the fault plane and intersects the surface at a point 10 feet west of surface ground zero. Field observations indicate that four high-angle joint sets are developed within the Ribbon Cliff formation — two major sets that have average strikes of N65°W and N55°E, and two minor sets that have average strikes of N16°W and N15°E. Low-angle bedding joints may be present locally. Joints of the dominant sets have an average spacing of less than 2 feet. Minor joint sets have spacings that vary from 3 to 10 feet. A comparison of surface observations with the results of a brief analysis of borehole photographs indicates a significant decrease in the frequency of joints with depth. The average physical property values of the porphyritic trachyte were determined. Geophysical logging consisting of density and caliper logs disclosed that the in situ density values obtained for depths less than 150 ft were not quantitatively comparable to values determined in the laboratory due to the erratic variation in borehole diameter indicated by the caliper logs, but the trend of in situ density with depth below a depth of 150 feet appeared to approximate the trend indicated by physical tests, i.e., no major variation of density with depth. Pressure tests indicated that permeability of the media at the Palanquin site was approximately 35×10^{-4} cm/sec near the surface and decreased to practically zero at a depth of 110 feet. Between depths of 203 and 213 feet, the permeability was 27×10^{-4} cm/sec. Reliable test data were not obtained for other depths. (auth)

51125 (PNE–966) PRESHOT GEOLOGICAL ENGINEERING INVESTIGATIONS FOR PROJECT CABRIOLET, PAHUTE MESA, NEVADA TEST SITE. Hunt, Richard W.; Bailey, Duryl M.; Carter, Louis D. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). June 1967. 82p. Dep. CFSTI.

The site of the Cabriolet experiment is on Pahute Mesa, Nevada Test Site. The site media, explored by four borings, consist of porphyritic trachyte overlain by a thin soil layer. Fractured, vesicular zones in the upper portions of the borings yielded poor core recovery, while higher core recovery was obtained at depth in dense, less fractured rock. Flow layers strike approximately N35°E at the surface and impart a pronounced structural grain to the rock. At depth, most joints roughly parallel the flow layering and strike N20°E. Joint spacing ranges from less than 0.1 to greater than 10 feet. Four high-angle faults are suspected in the vicinity of the site. Three of these strike roughly north-south and pass 200, 380, and 680 feet west of the site. The fourth inferred fault strikes approximately N63°E and passes 480 feet north of surface ground zero. For dense, unfractured rock, the bulk density, saturated surface-dry basis, averages 158.5 pcf, while the bulk density, dry, averages 156.2 pcf. The porosity averages 4.5 percent, and the unconfined compressive strength averages 12,952 psi. The vesicular material, based on one specimen, had a bulk density, saturated surface-dry basis, of 136.1 pcf, while the bulk density, dry, was 129.1 pcf. The porosity was 21.3 percent, and the unconfined compressive strength was 7,090 psi. (auth)

51126 (PNE–1115) INTERMEDIATE RANGE GROUND MOTIONS FOR PRE-GONDOLA II AND ASSOCIATED EVENTS. Power, Dean V. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1968. 76p. (UCRL–50433). Dep. CFSTI.

Ground motion records from seven high explosive cratering events in northeastern Montana were analyzed for peak velocity, power spectral density, and velocity spectra. The events included four 20-ton single charges at depths of burst which varied from 42 to 57 ft, a 140-ton row charge consisting of three 20-ton charges and two 40-ton charges at optimum depths of burst, and a fully coupled charge of 0.5 tons and a decoupled charge of 0.5 tons at optimum depths of burst. It was found that at these depths and charge weights an increase in depth of burst resulted in an increase in peak velocities and power spectral densities as measured at distant points (>5 km), while no significant frequency shifts were noted. Power spectral density was found to be approximately proportional to the first power of yield. For this reason it was determined that power spectral densities varied inversely as radius to the 3.55 power, and peak velocities varied inversely as radius to the 1.6 power. An increase in both velocities and power spectral densities for small decoupling factors was found to occur for a certain explosive-cavity configuration. Three analysis techniques, peak velocity, velocity spectra, and power spectral density, are compared and it is shown that power spectral density is the most consistent method when comparing records from different measuring stations. (auth)

51127 (SC–RR–68–449) CRATER FORMED BY DETONATING A ROW OF CHARGES BENEATH A RIDGE. Vortman, L. J. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1968. 39p. Dep. CFSTI.

A row of 64-pound charges was placed 7 feet below the top of a nearly four-foot high ridge formed by the arc of a circle with its center at the row axis. The row of charges was 5 feet below the original ground surface. The volume of the resulting crater was 86 percent and 60 percent greater than craters from rows 5 feet and 7 feet deep, respectively, below level terrain. Even if the portion of the ridge above the level-terrain plane (providing an effective burial depth of 5 feet) is disregarded, directed blasting still provides an increase of 32 percent in volume excavated over a row buried 5 feet below level terrain. More material is ejected laterally, hence less falls back into the crater than if the ground had been level. Vertical displacement of the surface over the charges is comparable during the first 12 milliseconds, but thereafter is greater as a result of the interaction of charges in the row. (auth)

51128 INTERSTELLAR TRANSPORT. Dyson, Freeman J. Phys. Today, 21: No. 10, 41-5(Oct. 1968).

The feasibility of the Apollo and the ORION projects in relation to outer space travel are discussed. Two space ship designs using thermonuclear bomb detonations as energy sources are considered for long range space travel. The use of an ablating material in which a negligible mass of the material is vaporized by each bomb burst is discussed. Size and performance characteristics of heat sink and ablation-type space ships are presented. (F.S.)

51129 USE OF SHEATH IN CONCEALING UNDERGROUND EXPLOSIONS. Viswanathan, K. Def. Sci. J. (New Delhi), 16: 197-202(1966).

A theoretical formula was obtained for the decoupling of the seismic signals from underground explosions due to the introduction of a sheath of a stronger material on the cavity walls. The elastic-elastic decoupling clearly enhances the value of the elastic-nonelastic decoupling factor. The theory has applications in the concealing of underground nuclear and chemical explosions. (Indian Sci. Abstr.)

51130 USE OF NUCLEAR EXPLOSIVES IN OIL AND GAS PRODUCTION. Coffer, H. F.; Grier, H. E.; Aronson, H. H. (CER Geonuclear Corp., Las Vegas, Nev.). CIM (Can. Mining Met.) Bull., 61: 739-50(June 1968).

Nuclear explosions are currently being planned for use in oil and gas production, the recovery of oil from oil shale, gas storage and copper leaching. The current status of each of these projects is discussed, with emphasis on the economics of each application. The first commercial application of nuclear explosives will be in gas stimulation. Project Gasbuggy will be rapidly followed by two additional shots, also related to gas production. These three events, each in a different formation, are described with a discussion on their significance to the world's oil and gas industry. The use of nuclear explosives in oil and gas stimulation should be a standard accepted practice within a few years. Calculations based on explosions in media such as tuff, alluvium, granite and dolomite predict large increases in productivity when nuclear devices are used in tight, thick formations. The broken-up rock resulting from the explosion becomes the new well bore, with a production rate of six to twelve times that of a normally completed well. The real or possible problems associated with nuclear explosive engineering are discussed. The only major foreseeable problem is the seismic shock wave. This limits the size of ex-

plosion which can be used near important surface structures. The radiation problem is considered to be largely psychological in the case of contained explosions. (auth)

51131 OBSERVATION ON THE RADIOACTIVE FALLOUT ORIGINATED FROM THE CHINESE NUCLEAR EXPLOSIONS. Kawai, Hiroshi (Kinki Univ., Japan); Nishiwaki, Yasushi. Hoken Butsuri, 3: 273-9(June 1968). (In Japanese).

Properties of radioactive fallout originated from the first, second, third, fourth, and the fifth Chinese nuclear explosions were observed. The differences in gross beta-activities, activities per unit volume and their particle sizes of highly radioactive particles are discussed with relation to the differences in burst conditions among the five explosions from which they originated. It was found that radioactivities of the highly radioactive particles were roughly proportional to their volumes. The differences in the radioactive decay rates of highly radioactive fallout particles were found in connection with their colors. From the results of decay characteristics of gross beta-activities and γ-ray spectra of fallout samples, it was found that the contribution of radioactivities of ^{239}Np in samples from the fifth Chinese explosion was larger than that from the third Chinese explosion. In comparison between the γ-ray spectra of highly radioactive fallout particles from the third and the fifth Chinese explosions, the particles from the third Chinese explosion were enriched in $^{95}Zr + ^{95}Nb$ and impoverished in ^{103}Ru, while on the particles from the fifth Chinese explosion, the reverse was observed. (NSA of Japan)

Facilities and Equipment

Refer also to abstracts 50956, 51211–51214, 51216, 51217, 51874, 52070–52074, 52276, 52580, 52603–52606, 52692, and 53279.

51132 (AERE-R-5808) THE DESIGN OF A VENTILATED THERMAL AND MECHANICAL SHIELD FOR A HEAVY LEAD SHIELDED FLASK WHICH CONTAINS A HEAT EMITTING SOURCE. Dixon, F. E.; (and others) (Atomic Energy Research Establishment, Harwell (England)). July 1968. 50p. Dep. CFSTI. UK 10s. 0d.

An account is given of experimental work to prove the design of a steel reinforced hardwood case provided with ventilation to disperse the heat emitted by the flask contents. Thermal and mechanical tests are described, and design recommendations are made. (auth)

51133 (BAW-1280-56) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Quarterly Progress Report, January–March 1968. (Babcock and Wilcox Co., Barberton, Ohio. Power Generation Div.). Sept. 20, 1968. Contract AT(11-1)-1280. 17p. Dep. CFSTI.

An evaluation was made of four alternate ways to redesign the Prototype Steam Generator to eliminate the stainless steel pressure parts. It was recommended that a new Croloy $2\frac{1}{4}$ boiler-superheater bundle be designed for installation in the existing shell. The sodium-to-steam heat exchanger study is proceeding with the selection of alternate concepts to the reference design for further study. Conceptual studies for FFTF Reactor Vessel are being made of three vessel concepts; the annular downcomer, the piped downcomer, and the bottom inlet piped downcomer. (auth)

51134 (K-L-2963) DESIGN CONSIDERATIONS FOR A PLUTONIUM HEXAFLUORIDE COLD TRAP FOR THE BROMINE HALIDE VOLATILITY PROCESS. Dunthorn, D. I. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 1, 1968. Contract W-7405-eng-26. 14p. Dep. CFSTI.

The design for a plutonium hexafluoride cold trap for the bromine pentafluoride volatility process has been outlined. Based on present estimated process flow conditions (for efficient recovery of plutonium hexafluoride), the unit must cool incoming gases to at least −90°C, making a coolant temperature below −100°C desirable. Use of liquid nitrogen is discouraged, since it can condense fluorine, thus giving rise to potential operating and safety problems. Liquid argon is, however, satisfactory. For an argon coolant, traps may be sized using the graphs which are presented. A trap to handle 11.5 pound-moles per hour flow would require about 100 square feet of surface area and a cross-sectional flow area of about 1.5 square feet. The problem of plutonium hexafluoride solid buildup in such a unit is not appreciable over a process cycle, a spacing of $\frac{1}{8}$ inch between cooling fins being sufficient to prevent plugging even at the point of maximum deposit within the unit. (D.L.C.)

51135 (KY-F-93) THE PROCEDURE USED IN DISCONNECTING, REBUILDING, AND CONNECTING FLUORINE CELLS. Procedure was Utilized in 1961. (Paducah Gaseous Diffusion Plant, Ky.). Apr. 10, 1968. Contract W-7405-eng-26. 13p. Dep. CFSTI.

For drawings see CAPE 55 and CAPE 486.

Step-by-step instructions are given on how to disconnect, dismantle, clean, repair, reassemble, and install fluorine cells. (L.C.L.)

51136 (LA-4001) COMPUTER PROGRAM FOR CALCULATION OF PARTICLE SIZE DISTRIBUTION FROM SEDIMENTATION DATA. Olson, J. D.; Campbell, G. M. (Los Alamos Scientific Lab., N. Mex.). Aug. 28, 1968. Contract W-7405-eng-36. 21p. Dep. CFSTI.

A new mathematical method of obtaining particle size distribution from sedimentation data is developed from the same assumptions as the traditional Oden method. The main advantage of this method is that it eliminates the necessity of drawing tangents required by the Oden method. A computer program to solve the simultaneous system of equations obtained from this theory and to calculate the distribution results is described. A comparison was made of results obtained from a typical sedimentation experiment using this method and the Oden method. (auth)

51137 (ORNL-TM-2080) DESIGN OF BOILER-SUPERHEATER UNITS FOR REPRESENTATIVE CESIUM AND POTASSIUM SPACE POWER PLANTS. Robin, T. T. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 88p. Dep. CFSTI.

Boiler designs were developed for both K and Cs systems. Two design approaches were used. The first was based on using vortex generator inserts to centrifuge droplets to the walls and thus improve heat transfer in the transition region. The second was directed toward design for low-liquid entrainment in the boiling region. The results indicate that the Cs boiler is heavier than the K boiler by a factor of 1.3 for the vortex generator approach, and by a factor of 2.7 for the low-liquid entrainment approach. Further, it appears that the low-liquid entrainment approach yields boilers that are smaller by a factor of about 3 to 5 and lighter by a factor of about 2 for K; for Cs the weight saving from use of the low entrainment approach appears to be only about 20%. (auth)

51138 (ORNL-TM-2351) FLUX PUMPS AS POWER SUPPLIES IN COMPARISON WITH ALTERNATIVES. Lubell, M. S.; Efferson, K. R. (Oak Ridge National Lab., Tenn.). Aug. 29, 1968. Contract W-7405-eng-26. 13p. Dep. CFSTI.

Losses associated with energizing a superconducting magnet were studied by comparing the losses for various modes of operation of a flux pump and vapor-cooled input leads. Losses of vapor-cooled leads surpass flux pump losses. Flux pumps are found to be more efficient. To reduce losses in operating large magnets where rotating magnet flux pumps are unsuitable, vapor-cooled leads are used to energize the magnet. After maximum current is reached, the system is placed in persistent mode with a superconducting short. To reduce heat leaks, the current contact can be opened. It may also be necessary to employ a flux coil detection system which can be used to remotely control a motor to reconnect the vapor-cooled leads when needed. (F.S.)

51139 (UCRL-Trans-1377) MASS-SPECTROMETRIC ANALYSIS OF THE CONCENTRATIONS AND DIFFUSION COEFFICIENTS OF GASES IN METALS. Fistul, V. I. Translated for Univ. of California, Lawrence Radiation Lab., Berkeley, from Tr. Kom. Anal. Khim. Akad. Nauk SSSR, Inst. Geokhim. Anal. Khim., 10: 71-81(1960). 13p. Dep. CFSTI.

Techniques are proposed for finding the diffusion coefficients and concentrations of gases in metals based on comparison of the calculated data with the experimental results obtained by means of a mass-spectrometer. The calculation techniques which are proposed are approximate as a result of the assumed simplifications, but they permit an advance idea of liberation of gases from real metal parts, in particular, parts of electrovacuum instruments. More exact calculation techniques may be developed by solving the diffusion equation with boundary conditions reflecting the quadratic relations between the gas concentrations in the metal and on the metal in the case of equilibrium. (tr-auth)

51140 (WAPD-Trans-95) STRESS-RELIEF ANNEALING OF NUCLEAR REACTOR TANKS: AN UNSOLVED METALLURGICAL PROBLEM. Sebille, J. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from pp 171-91 of Recurring Inspection of Nuclear Reactor Steel Pressure Vessels. Report of Panel held in Pilsen, Czechoslovak Socialist Republic 3–7 October 1966, International Atomic Energy Agency, Vienna, 1968. 33p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 10430. (R.C.K.)

51141 SAPPHIRE WINDOWS PROVIDE A CLOSE-UP VIEW OF HOT SUBJECTS. Instrum. Contr. Eng., 2p.(Aug. 1967).

Sapphire windows brazed to metal supports simplify the task of making precise but routine measurements in the high temperature/high pressure fields. These windows may be used up to 350° in air and up to 500°C in protective atmospheres. The pure variety of artificially produced sapphire exhibits high transmission in the infrared region and is transparent to ultraviolet. (F.S.)

51142 VENTILATION AND ACTIVITY MONITORING OF THE AIR IN MEGACURIE CELLS. Scheeder, K. M. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Atomwirt., Atomtech., 13: 435-7(Aug.-Sept. 1968). (In German).

A hot cell installation for technological and metallurgical investigations of nuclear fuels and structural materials for reactors was set up in the Nuclear Research Centre Karlsruhe. It consists of five concrete cells and various investigation facilities which are shielded with concrete, lead or steel. The main prerequisite for the operation of hot cells is the safety of the personnel and surroundings against the materials being handled. The greatest significance in such installations attaches to the ventilation and the monitoring of the radioactivity in the air. Their design data, technical prerequisites and protective measures are described using the hot cells in Karlsruhe as an example. The air for ventilation is taken in about 10 m above ground level, filtered, humidified, heated or cooled, led through the rooms, filtered again before the exit and finally returned into the atmosphere through a 60 m high chimney. The installation pressure is below that of the external atmosphere, the differential being greatest in the cells themselves. The ventilation plant is as far as possible automatically controlled. It compensates, by a pneumatic control plant, any very rapid variations in the sub-pressure in the buildings. The air control is oriented to the detection of plutonium isotopes since irradiated fuels are studied. The air in the cells can be changed five to fifty times an hour according to the requirements of operation. (auth)

51143 WORK PROGRAM AND EQUIPMENT OF HOT CELLS 1 AND 2 AT JUELICH. Mueller, H.; Stradal, K.; Witte, H. (Kernforschungsanlage, Juelich, Ger.). Atomwirt., Atomtech., 13: 444-8(Aug.-Sept. 1968). (In German).

Planning began as long ago as 1958 in the Nuclear Research Centre Jülich (KFA) for hot cells which would be as versatile as possible in operation. Provision was made for post-irradiation investigations on fuel elements, fuel specimens and irradiation equipment as well as work on radioactive constructional parts. The hot cells will be completed shortly and the first hot work is planned for the autumn 1968. A hot laboratory, suitable for a limited range of tasks, was built and put into operation in 1967. It was necessary in addition to equip a section of the hot cells for chemical work since the planned chemistry cells will not be available before 1971 and it was essential that experiments on the reprocessing of irradiated fuels be in progress by the end of 1968. The "Hot Cells" laboratory is divided between two buildings; one contains the active part of the laboratory and operational rooms immediately connected with them, the other contains the remaining facilities such as ventilation, water and the electrical plant. The concrete cell series HC1 and HC2 were poured as solid closed units. The cell walls consist of baryta concrete which is faced internally and externally with steel plates, the inner facing being plated with stainless steel. All openings, such as plugs, doors and windows are provided with gasket seals in order to make the cells gas-tight. (auth)

51144 PRESENT STATE OF THE DEVELOPMENT AND DESIGN OF LARGE IRRADIATION PLANTS FOR WORK IN RADIATION CHEMISTRY AND FOR IRRADIATING MATERIALS AND PRODUCTS. Osipov, V. B. (State Atomic Energy Committee, Moscow). pp 415-19 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In Russian).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The principal stages in the development of γ irradiation facilities, the design of various irradiation plants, and engineering and physical methods for determining the basic parameters of industrial irradiators in the U.S.S.R. are presented. The successes achieved throughout the world over the last ten years in producing industrial irradiation plants are reviewed. (auth)

51145 NEW RIVAL FOR FLASH DISTILLATION. Lynam, J. P. Power, 112: No. 9, 79(Sept. 1968).

A cost comparison is made of 3 methods for water desalting: falling-film distillation, flash evaporation, and vapor compression. It is concluded that, contrary to previous assumptions, in a diesel-driven plant, the vapor compression method offers the greatest overall economy. (L.C.L.)

51146 AIR GAGE POT CHUCK (Engineering Materials). (Dow Chemical Co., Midland, Mich.). (CAPE-1770).

2 drawings.

An open air-jet is described which is mounted in a work-holding fixture to measure the work-piece seating location prior to machining. Machine tool compensation is then made to eliminate final product error due to inconsistent seating of parts. For gaps of zero to 0.0025 in. the accuracy of the system to within ±0.0001 in. (For details see TID-4100 Suppl. 48; see also 22: 30748) (F.S.)

51147 INVESTIGATIONS ON IRRADIATED HIGH TEMPERATURE REACTOR FUELS. Groos, E.; Pott, G.; Stockschlaeder, F.; Thiele, B. (Kernforschungsanlage, Juelich, Ger.). Atomwirt., Atomtech., 13: 449-52(Aug.-Sept. 1968). (In German).

In the Nuclear Research Centre Juelich (KFA), nuclear fuels and fuel elements are also being developed and tested in parallel with the development of a thorium high-temperature reactor (THTR Project). Following irradiation experiments which are being carried out under the conditions of the planned reactor, post-irradiation tests are undertaken on the irradiated fuels. So far open fuel particles or fuel element spheres in closed instrumented capsules have been irradiated. The work is carried out in gas-tight boxes which are connected to each other by a transport tunnel. The individual cells serve the following purposes: Cell 1—insertion, disassembly and specimen removal; Cell 2—annealing tests; Cell 3—material testing and dimensional measurements; Cell 4—preparation of specimens for metallography; Cell 5—waste handling, channeling in and out; and Cell 6—microscopy. A typical sequence of investigations on irradiated capsules comprises the dismantling of the irradiation equipment, the puncture test for the withdrawal of a specimen in which the unwashed, gas-tight capsules are drilled, the inspection of the capsule parts in which the surface changes are established and photographed at a maximum telescope magnification of 12×, dimensional measurements, annealing tests, removal of specimens from the graphite parts, drop and compression tests on the spherical fuel elements, corrosion tests, metallographic investigations. In the investigations special value is attached to high mechanical stability of the fuel particles and to impermeability for fission products. These properties are investigated on loose particles in relation to various parameters such as burnup, faster neutron flux and temperature. (auth)

51148 POSSIBILITIES AND LIMITATIONS CONCERNING THE GENERATION OF MEGAOERSTED FIELDS. Knoepfel, H. (EURATOM-CNEN, Rome). Helv. Phys. Acta, 41: 993-7(Oct. 20, 1968).

A brief review of the actual state of very high magnetic field research is given, with particular attention to the results obtained in Frascati. (auth)

51149 BRIEF DISCUSSION ON A PLANT FOR SEPARATING ^{235}U BY GAS CENTRIFUGATION. ECONOMIC EVALUATION ON A NOVEL GAS CENTRIFUGATION PROCESS BASED ON CERTAIN ASSUMPTIONS. Kikuchi, Hidehiko (Chiyoda Chemical Engineering and Construction Co., Ltd., Japan). Nippon Genshiryoku Gakkaishi, 10: 441-3(Aug. 1968). (In Japanese).

Gas centrifugation is presently under extensive study and development. A feasibility study has been made on a number of alternative uranium separation plants of different scale of operation that assumes the use of a conventional type of gas centrifuge that should be operative soon. A plant based on this new gas centrifugation process was examined from the economical standpoint and compared with the conventional plants mentioned above. As a result, it is suggested that this new process, if successfully developed, could be advantageously utilized to build a less expensive plant for separating uranium isotopes. It is further pointed out that data based on the present state of the gas centrifugation art clearly evidence its economic inefficiency against the gaseous diffusion process for separating the isotopes of uranium on a relatively large scale. (auth)

51150 POST-IRRADIATION INVESTIGATIONS IN THE HOT CELLS OF THE AEG. Blass, S.; Weidinger, H. G. (AEG-Telefunken, Grosswelzheim, Ger.). Atomwirt., Atomtech., 13: 441-3(Aug.-Sept. 1968). (In German).

Hot cells should be of universal application with the greatest possible capacity. The characteristics of the hot cell installation, therefore, should include very generous shielding and working space, universal handling capabilities for all kinds of active materials through the gas-tightness of the whole cell block, high flexibility through the interchangeability of all important components, and through modular construction with standard dimensions, as well as maintaining stacks of all maintenance and auxiliary equipment. The plan of the cell block is "U" shaped because this ensures a particularly rational relation of the working volume of the cells to the service space which is situated in the inside of the "U." The cells are operated from the outside of the "U" to ensure sufficient sites for the parallel working remote operating

stations. The functional arrangement of the cells is related to the requirements of fuel element investigations. A radiochemical laboratory capable of handling medium activities is available for supplementary work with lower activities. (auth)

51151 SURVEY OF F.R.G.: WAK PLANT FOR REPROCESSING. Schueller, W.; Zuehlke, H. (GWK, Leopoldshafen, Ger.). Nucl. Eng., 13: 768-70(Sept. 1968).

The prototype Purex plant which is described is designed to permit use as a developmental tool while giving experience of full scale technical operation. The project organization, site selection, and progress are discussed. (UK)

51152 THE DESIGN OF A DIGITAL CONTROL PANEL FOR A ^{60}Co RADIOTHERAPY UNIT. White, D. R.; Mallion, W. E.; O'Connor, A. D. (Kent and Canterbury Hospital, Canterbury, Eng.). Med. Biol. Eng., 6: 341-4(June 1968).

A 3-section digital panel, consisting of a dose-rate module, dose module, and electronic timer, for computing and controlling treatment times after the dose rate and tumor dose have been selected, is described in detail. Characteristics of the ^{60}Co unit operation are summarized. The console and its operation are outlined. The dose-rate module is a variable decade oscillator with a frequency range 0 to 299 cycles/min, linear with conductance. A multivibrator is used with silicon transistors, metal oxide resistors, and tantalum capacitors for stability. A commercial dc power supply provides the 12 V, giving a ripple content of less than 2.5 mV peak and stabilization ratio of 1000:1. The frequency range requires 20 different resistances in the circuit, each made up of a single metal oxide resistor and a professional wire-wound trimming potentiometer. Three 12-way, 3-bank, plug-in uniselectors are used to connect the resistances in parallel. A given frequency, which is equivalent to a desired radiation dose rate, may be selected by an impulser which is the transistorized dialing circuit from a push-button telephone. The dose rate is displayed on cold cathode digital tubes. The dose module is a commercial dual batch counter, 1 display counts down and 1 counts up. The required dose (0 to 9999 rad) is selected by the impulser and 4 uniselectors. When the counting down display reaches zero a relay terminates the treatment. The third module, an electronic timer, operates to 60 min in 0.1 sec units. (BBB)

51153 IRRADIATION DEVICE. Sekita, Junichiro (to Rigaku Denki Co., Ltd.). Japanese Patent 1968-10718. May 9, 1968. Filed Feb. 17, 1965.

In the irradiation device described, a unidirectional irradiation hole is in the radiation source container itself. When irradiations are not being made, the source is removed from the position of the hole so that the shielding plug can be inserted into the hole safely. The irradiation device, which is actually a source container, consists of the following: the shielding container body; a horizontal hole running through the body; a conical unidirectional irradiation hole, cut in the shielding body at right angles to the horizontal hole joining to this hole; a shielding plug to be inserted into the irradiation hole; a source holding rod movable through the horizontal hole, in which the radiation source is contained; a spring in the horizontal hole extending inward from one end of the hole which always presses the source holding rod so that the source-holding hole is away from the conical hole position; a source-holding rod handling device which brings the source-holding hole to the irradiation hole position by pulling the rod against the spring force and moving it away from the position by means of the spring force. (NSA of Japan)

51154 SEPARATION OF THE CORE OF A URANIUM FUEL ELEMENT FROM ITS ENVELOPE. Raviv, Szmuel; Rabinovitz, Elsa; Malkiely, Shimon. British Patent 1,129,698. Oct. 9, 1968. Filed Sept. 28, 1967.

A method for decladding spent uranium fuel elements is described. The method consists of inserting the fuel element in a nitric acid bath with 7 to 12 N concentration. While in the bath, the U core is connected as a cathode into an electrolytic circuit allowing electric current to flow until the core is loosened. The core is then extracted from the cladding. Uranium dissolves only at the contact surface, with no dissolution at the exposed free ends of the element. Current density on the cathode must be above 0.01 amp/dm^2 and should be 100 amp/dm^2 or higher. (F.S.)

51155 SHAKEDOWN INVESTIGATIONS ON PARTIAL PENETRATION WELDED NOZZLES IN A SPHERICAL SHELL. Procter, E.; Flinders, R. F. (Central Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Design, 8: 171-85(1968).

The elastic analysis of radial and oblique nozzles in a spherical shell, subject to internal pressure, has been described and discussed in an earlier paper. Tests on the same vessel, to investigate the shakedown behaviour at the nozzle to shell junctions are described. Three basic designs of partial penetration welded nozzles were investigated, one of each design mounted radially and the other at 45° obliquity. For the purpose of the elastic analysis and to observe the effects of increasing plasticity on stress die-away, four hundred E.R. strain gauges were fixed to the inner and outer surfaces of the shell plate and nozzles. To monitor the shakedown behaviour, however, it was only necessary to observe the gauges at the first yield positions, although other gauges did prove of value in certain aspects. Strain plots indicating the shakedown behaviour of each nozzle are shown. The results are compared with theoretical predictions and it is demonstrated that, for low carbon steels, shakedown loads can be calculated provided the plastic stress at first yielding positions can be determined. (auth)

51156 IRRADIATION TUBE FOR AN IRRADIATION DEVICE. Atobe, Hideo (to Hitachi Ltd.). Japanese Patent 1968-13837. June 12, 1968. Filed July 30, 1965.

An irradiation tube used for tests by penetrating radiation is described. It is designed so that the radioisotopic source can pass smoothly through the bent part of the tube. Slits are out in the wall of the bent part, either on one or both sides, to allow for smooth movement of the radiation source in this part. (NSA of Japan)

51157 PILOT PLANTS: MAINTAINING A NUCLEAR RESEARCH LABORATORY. Boyd, J. L.; Dunigan, P. F. X. (Battelle Memorial Inst., Richland, Wash.). Chem. Eng. Progr., 64: No. 10, 54-8(Oct. 1968).

Special techniques required in the staffing and operation of nuclear research laboratories are described. The administration of maintenance, engineering, and related functions in nuclear laboratories is investigated. Organizational schemes and underlying management philosophies are discussed. It is concluded that the system described has definite advantages because plant engineers are available for various assignments. (R.C.K.)

Heat Transfer and Fluid Flow

Refer also to abstracts 51137, 51193, 52227, 53466, and 53481.

51158 (AGN-8195(Vol.2)) THERMOPHYSICAL AND HEAT TRANSFER PROPERTIES OF ALKALI METALS. VOLUME II. Achener, P. Y.; Mackewicz, W. V.; Yee, D.; Camp, D. C. (Aerojet-General Corp., San Ramon, Calif. Nuclear Div.). Aug. 1968. Contract AT(04-3)-368. 387p. Dep. CFSTI.

The causes and magnitude of differences in the heat transfer characteristics of alkali metals and those of ordinary fluids are examined. An extensive literature review was performed, and selected data on the heat transfer properties of alkali metals are presented. Empirical correlations or theoretical solutions are recommended only when they are reasonably verified by several sets of data. Separate discussions are presented for: forced convection heat transfer with laminar flow, with turbulent flow, and to fluids outside tubes; boiling heat transfer; and condensing heat transfer. (H.D.R.)

51159 (ANL-7431) DESIGN AND TESTING OF A HIGH-HEAT-FLUX ELECTRON-BOMBARDMENT HEATER. Carlson, R. D.; Holtz, R. E. (Argonne National Lab., Ill.). Mar. 1968. Contract W-31-109-eng-38. 33p. Dep. CFSTI.

The applications of electron-bombardment heating to liquid-metal heat transfer and reactor safety experiments are discussed. Space-charge-limited heater operation with both triode and diode concepts and emission-limited heater operation are evaluated. The design of a high-heat-flux, electron-bombardment heater (EBH) is presented. The operating results of the high-heat-flux EBH are presented. Heat fluxes ranging beyond 2.5×10^6 Btu/hr-ft^2 were obtained. Long periods of EBH operation at high heat fluxes were achieved. Curves showing the operating characteristics of the high-heat-flux EBH are also presented. (auth)

51160 (BNWL-848) REVIEW OF PARTICLE TRANSPORT IN A CONDENSING STEAM ENVIRONMENT. Horst, T. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 24, 1968. Contract AT(45-1)-1830. 45p. Dep. CFSTI.

Aerosol transport and deposition in an environment consisting of a mixture of air and saturated steam adjacent to a heat transfer surface on which condensation is occurring is discussed. Basic information is drawn together regarding those phenomena which are unique to a condensing steam environment or are altered by the presence of condensing steam, with the view of prediction of particle transport from first principles. These phenomena include condensation in the presence of an inert gas, diffusiophoresis, thermophoresis, particle nucleation and growth, and Brownian and turbulent diffusion. Judgment is made of the probable relative importance of these various mechanisms for aerosol demobilization following a loss-of-coolant accident in a water cooled reactor. This compilation of background material is the base for an experimental and theoretical study to extend knowledge of particle transport in a condensing steam environment. (auth)

51161 (GEMP-616) A BRIEF PROGRAMMER'S INTRODUCTION TO VERSION E OF THE TRANSIENT HEAT TRANSFER COMPUTER PROGRAMS (NMP-857). Skirvin, S. C. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). July 1, 1968. Contract AT(40-1)-2847. 59p. Dep. CFSTI.

A brief, programmer-oriented description is given of Version E of the Transient Heat Transfer digital computer programs (THTE). THTE provides a solution capability for large, complex three-dimensional transient and steady-state heat transfer problems which can include conduction, convection, and radiation with the option to compute fluid flow rates on a one-dimensional basis. THTE is coded in the FORTRAN-IV language, but employs list-processing concepts unusual for this language; these are described in detail. The availability status is outlined. (auth)

51162 (IFA-F.R.-60) METHOD OF ELECTROHYDRODYNAMICAL COOLING OF EXOTHERMAL RODS. Rosu, H. N. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 6p. Dep.

An aluminum plaque 80 by 15 by 1.5 mm was designed and is used to improve the efficiency of uranium rod cooling in the VVR-S reactor. The rod was subjected to a nonuniform electrostatic field which improved heat transfer between the rod and the cooling agent. This heat transfer process is known as thermal electroconvection, surface electroconvection or electrohydrodynamic cooling. (F.S.)

51163 (LA-DC-9164) BRIEF DISCUSSION OF A METHOD FOR AUTOMATIC REZONING IN THE NUMERICAL CALCULATION OF TWO-DIMENSIONAL LAGRANGIAN HYDRODYNAMICS. Browne, Philip L.; Wallick, Karl B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 5p. (CONF-680815-1). Dep. CFSTI.

From International Federation for Information Processing Congress Conference, Edinburgh, Scotland.

A scheme is presented for rezoning in two-dimensional Lagrangian numerical hydrodynamics calculations of compressible flow. This rezoning is based on a model of a two-dimensional Lagrangian mesh, for which it is possible to do the rezoning automatically and at the same time conserve mass, momenta, and total energy as these quantities are transferred from one zone to another. The general procedure adopted is to run the problem hydrodynamically, but at the same time monitor the mesh for distortion. When the distortion becomes severe, the problem is interrupted and the rezone code takes over to clear up the mesh distortion. (auth)

51164 (LMEC-Memo-68-9) LIQUID METAL FLOW MEASUREMENT (SODIUM) STATE-OF-THE-ART STUDY. Turner, G. E. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). June 28, 1968. Contract AT(04-3)-700. 74p. Dep. CFSTI.

Various types of flowmeters are described and their advantages and disadvantages as applied to liquid metal flow measurement are discussed. It is concluded that the permanent-magnet-type flowmeter most closely meets the requirements of the ideal flow measuring device for use in liquid metal systems. (auth)

51165 (UCRL-50453) CRITICAL REVIEW OF HEAT PIPE THEORY AND APPLICATIONS. Cheung, Henry (California Univ., Livermore. Lawrence Radiation Lab.). July 15, 1968. Contract W-7405-eng-48. 70p. Dep. CFSTI.

A critical review of the theories and experiments relating to heat pipes was made to provide an introductory reference which summarizes and interprets the information useful in practical applications. The areas to be studied to extend current knowledge are indicated. The open literature up to March 1968 is evaluated and interpreted. (auth)

51166 HEAT TRANSFER IN TURBULENT FLOW WITH INTERNAL HEAT GENERATION IN CONCENTRIC ANNULUS. I. FULLY DEVELOPED THERMAL SITUATION. Michiyoshi, Itaru; Nakajima, Tsuyoshi (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 5: 476-84(Sept. 1968).

The problem of heat transfer in fully developed turbulent flow with uniform internal heat generation in a concentric annulus under conditions of uniform but different heat fluxes at the two wall surfaces is discussed. The Nusselt numbers at each wall surface are calculated by analyzing the radial distribution of the fluid temperature. Approximate equations are derived which are found to represent very well the analytical results. The Nusselt numbers vary with the ratios of the radii of annular space as well as of the wall heat fluxes, as also with internal heat generation. These predictions agree well with available experimental data for various fluids. (auth)

51167 INSTANTANEOUS HEAT-EMISSION OF THIN WIRES IN A NONSTEADY GAS FLOW. Pelepeichenko, I. P.; Simbirskii, D. F. Samoletostr. Tekh. Vozdush. Flota, No. 5, 82-5(1966). (In Russian).

The instantaneous emission of heat from wires made of tungsten of 0.02, 0.05, and 0.1 mm dia and 60 mm long washed by a transverse flow of air with harmonic variation of the velocity with frequencies from 0.6 to 13 cps and instantaneous velocities from 9 to 40 m/sec was investigated. The wire was heated by an electric current, and on the assumption of the constancy of the temperature across its section and knowledge of the value of the resistance of the wire, the instantaneous coefficient of emission of heat was found. Further, according to the coefficient of heat transfer, the number N was calculated and according to the velocity of the flow, the number R was measured by an anemometer. The physical parameters of the air were referred to the mean temperature. From the analysis of the data obtained, it follows that in the conditions of the experiment the problem of heat-emission is a quasi-steady one and that with accuracy to ±7% it is described by the dependence relationship $N = 0.766R^{0.476}$. (auth)

51168 TWO-PHASE COMPRESSIBILITY IN LIQUID METAL SYSTEMS. Fauske, Hans K. (Argonne National Lab., Ill.). pp IVa1.1-12 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Available analytical methods and experimental data pertaining to two-phase compressibility phenomena (critical flow and the velocity of sound) are summarized. These are generally limited to non-metallic systems (steam-water). Liquid Na vapor critical flow data including stagnation temperatures up to 1600°F, critical pressures from 1 to 6 psia, and critical flow rates ranging from 100 to 1000 lbs/sec-ft^2 are presented. The data include also approximate values for the initial superheat sustained before flashing. Similar data are presented for non-metallic fluids (water) collected with test sections and procedures identical to those used for the sodium experiment. A direct comparison between the two sets of data is presented, suggesting that correlations developed for steam-water data can be extrapolated to metallic fluids (sodium). (auth)

51169 EXPERIMENTAL STUDIES ON SODIUM BOILING. Le Gonidec, B. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes, France); Rouvillois, X.; Semeria, R.; Lions, N.; Robin, M.; Simon, A. pp IIb3.1-22 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

An analysis of acoustical phenomena accompanying boiling was carried out to detect bubble collapse. Most recent results are given for boiling NaK and sodium in pool boiling for pressures of about 0.08 bar and fluxes of 30 to 200 W/cm^2. These tests show that the frequency spectrum of the wave is rich in high frequency components; detections have been made in the 45 to 380 Kcs range. The total plugging of a subassembly inlet was studied experimentally in a simplified way, by using a circular Inconel tube with 6 mm ID filled with stagnant sodium and closed at its lower end. This tube was heated by the Joule effect over a length of 400 mm. Sodium superheat from 20 to 200°C above boiling temperature was observed in the majority of cases. The explosive formation of vapor leads to sodium ejection beyond the heated section. Mechanisms of this expulsion are analyzed and simplified models are proposed. Expulsion of superheated water–obtained by depressurization–is characterized by the same mechanisms. The analogies and differences of behavior of the two fluids are discussed. (auth)

51170 MEASUREMENTS OF THE SUPERHEATING AND STUDIES ABOUT BOILING PHENOMENA IN LIQUID METALS. Grass, G.; Kottowski, H.; Spiller, K. H. (EURATOM, Ispra, Italy). pp IIb4.1-12 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Boiling of potassium and sodium was studied in stagnant conditions and in the cases of natural and forced convection. The maximum superheating temperature of the liquid metal was measured before boiling. The measured superheating varied from about 20° to 820°C depending on the liquid metal used and the test conditions. Vaporization was generally followed by expulsion of liquid metal columns due to the generated vapor. The expansion of the vapor volume was measured. Important parameters for the ejection time were the initial vapor pressure (corresponding to the initial superheating at the moment of incipient boiling) and the pressure evolution while ejecting. A model describing the phenomenon is given. (auth)

51171 SUPERHEATING OF SODIUM AND THE GENERATION OF PRESSURE PULSES. Holtz, Robert E.; Singer, Ralph M. (Argonne National Lab., Ill.). pp IIb5.1-11 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Experimental results are presented on the superheat necessary to initiate boiling of sodium and the associated pressure pulses. The effects of heat flux, system pressure, and pressure-temperature history are discussed and the results compared to theoretical predictions. The conditions under which sodium will boil stably or unstably are presented and discussed. (auth)

51172 VOID FRACTION MEASUREMENTS IN A TWO-PHASE FLOW NaK/ARGON. Milliot, B.; Lazarus, J.; Navarre, J. Ph. pp IIb7.1-16 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Several measuring methods were proved and calibrated for determining the void fraction in vertical two-phase flow of NaK. The emulsion was created by injecting argon in the liquid metal. Results were obtained in bubble flow using EM flowmeters, changes in electrical resistance, γ-ray attenuation, and two-phase pressure drop. All results are compared with each other and checked with the theoretical model of Marchaterre and Hoglund. As to the slip ratio some difference was observed. Moreover, all results have been plotted in the Lockhart-Martinelli diagram. (auth)

51173 ESTIMATION OF VAPOR AND LIQUID DENSITY AND HEAT OF VAPORIZATION OF THE ALKALI METALS TO THE CRITICAL POINT. Miller, David; Cohen, A. B.; Dickerman, C. E. (Argonne National Lab., Ill.). pp IIb9.1-14 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Recent experimental measurements of the vapor and liquid densities of Na, K, Cs and Rb have been used to estimate the critical constants of these materials by smoothing the data and requiring it to fit: the law of rectilinear diameters; a linear plot of the reduced density function $|\rho_R^{-1}|$ vs $(1-T_R)$ on log-log coordinates which is prescribed by the lattice-gas model of the critical point; and a heat of vaporization, calculated from the vapor pressure equation and densities, as a linear plot vs $(1-T_R)$ on log-log coordinates. Constants derived from the best fit to these requirements are presented for use in the calculation of thermophysical property data. The application of this information to the calculation of other properties of interest to reactor analysis such as thermal expansion coefficient, compressibility and the constant change in pressure due to a rise in temperature is discussed. Extension to reactor fuel materials and mixtures is also indicated. (auth)

51174 BURNOUT IN BOILING HEAT TRANSFER. PART II. SUBCOOLED FORCED-CONVECTION SYSTEMS. Gambill, W. R. Nucl. Safety, 9: 467-80(Nov.-Dec. 1968).

Selected recent developments regarding boiling burnout (or boiling crisis or departure from nucleate boiling) in subcooled flow systems are reviewed. Uncorrelated studies of burnout with water coolant are summarized, as are correlations applicable to liquid metal (Na), cryogens (N_2 and H_2), organic coolants (Santowax OM, orthoterphenyl, etc.), and water. Ten correlations proposed for water coolant are graphically compared for High Flux Isotope Reactor conditions. Other areas treated include buoyancy effects in downflow systems, flow instabilities associated with boiling, and studies relevant to specific reactors (Plum Brook Reactor, University of Virginia Research Reactor, DIDO, Advanced Test Reactor, and Plutonium Recycle Test Reactor). 78 references. (auth)

Isotope Technology

Refer also to abstracts 51123, 51149, 51156, 52233, and 53405.

51175 (AI-AEC-12739) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. COMPATIBILITY TESTING. Topical Report No. 5. Benn, E. (Atomics International, Canoga Park, Calif.). Sept. 15, 1968. Contract AT(29-2)-2338. 40p. Dep. CFSTI.

The Large Radioisotope Heat Source Capsule (LRHSC) Program supports the development of high temperature (2000°F) long life (5 years) radioisotope heat sources. The specific concern of the LRHSC program is to develop the tantalum alloy fuel containing capsule. The LRHSC test program is generating data on biaxial creep, impact deformation, burial temperature distributions and materials compatibility. Progress made in the design, testing, and evaluation of the LRHSC materials compatibility samples during fiscal year 1968 is presented. Test data are presented on interface combinations involving Ta-10W, T-111 (Ta-8W-2Hf), Al_2O_3, Pt-10Rh and iron titanate at temperatures in the range of 2000°F to 2500°F. (auth)

51176 (ALO-2510-2) SILICON-GERMANIUM THERMOELECTRIC MATERIALS AND MODULE DEVELOPMENT PROGRAM. 2nd Quarterly Report, April 1–June 30, 1968. (Radio Corp. of America, Harrison, N. J. Special Electronic Components Div.). Contract AT(29-2)-2510. 65p. Dep. CFSTI.

The characterization and improvement of SiMo hot shoe materials and the refinement of the fabrication and bonding techniques are discussed. SiC and coated graphite were selected for evaluation as alternate hot shoe materials and hot shoes of SiC were fabricated. A Cr coating to be applied by pack cementation to tungsten cold shoes was developed. Performance of a 5-watt device comparing the effect of Dynaquartz and MIN-K 2020 fibrous insulation was observed. The successful operation of a four-couple reference design module through a typical mission environmental cycle was completed. (J.C.W.)

51177 (ALO-3634-10) RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report, June–August 1968. Carvalho, J.; Dunlay, J. B.; Fronduto, J.; Paquin, M. L.; Poirier, V. L. (Thermo Electron Corp., Waltham, Mass.). Oct. 8, 1968. Contract AT(30-1)-3634. 64p. (TE-4059-46-69). Dep. CFSTI.

Progress is reported on the development of high-temperature thermal insulation for radioisotope power systems. The zero-time performance measurements of the short-term life test samples have been completed and the 1000-hour soak period is now underway. A change in the appearance of tungsten foil exposed to high temperature was noted and a series of tests conducted to establish the cause of the change. The tests designed to optimize the layer spacing in cylindrical samples have been completed and the minimum thermal conductivities were associated with the most tightly wrapped samples. By contrast, however, the minimum heat fluxes through a given number of layers were associated with layer spacings of 4.6 mils/layer. The performance of $Cu-ZrO_2$, $Al-ZrO_2$, $Ni-ZrO_2$, and $SS-ZrO_2$ insulations have been evaluated at temperatures between approximately 200 and 700°C. Thermal conductivities on the order of 10^{-6} watts/cm °C were measured. (auth)

51178 (IFA-IS-51) DETERMINATION OF TRANSFER CONSTANTS FOR A SEPARATION COLUMN BY SUCCESSIVE EXCHANGE BETWEEN THREE FLUIDS BY SIMULATION ON AN ANALOG CALCULATOR. Covaci, I.; Miron, C. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 10p. (In French). Dep.

A method is presented for determination of the transfer constants of a separation column with successive exchange between three fluids by simulation on an analog calculator. Exchange equations for the steady state are used and the form imposed on them by determination of the transfer constants is shown. The method for resolution of the problem is described, and programming of the equations on the analog calculator is given. Experimental results obtained are reported and errors of the method are discussed. The proposed method is simple, rapid, and valid at arbitrary concentrations. (tr-auth)

51179 (MLM-1532) CRITICALITY ANALYSIS OF THE LARGE HEAT SOURCE SYSTEM CONTAINING $^{238}PuO_2$ FUEL. Wolfe, R. A. (Mound Lab., Miamisburg, Ohio). Oct. 1, 1968. Contract AT-33-1-GEN-53. 9p. Dep. CFSTI.

A criticality analysis was made of a $^{238}PuO_2$ radioisotope heat source system that will provide 25 kW of thermal power to a Brayton cycle power conversion system designed for space application. The calculations revealed a considerable degree of subcriticality for the Large Heat Source System. The only credible mechanism that could result in criticality of the ^{238}Pu-fueled Large Heat Source System would be a massive meltdown of the capsules and reassembly of approximately one-fourth of the fuel in some container such as a reentry body. The occurrence of criticality would not create significant additional radiological hazards beyond or different in magnitude than those posed by possible fuel dispersal. (auth)

51180 (MMM-3824-23) SNAP-23A PROGRAM, PHASE I. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Report No. 6, April 1–June 30, 1968. (Minnesota Mining and Mfg. Co., St. Paul). Contract AT(30-1)-3824. 89p. Dep. CFSTI.

During the quarter, approval of the Prototype Mockup Converter (PMC) design was received; fabrication and processing of PMC-1 was completed; Converter EMC-2 was placed back on

long-term test after repairs were completed to the heat source assembly of the process and test station; and EMC-3 was placed on long-term test. The Prototype Mockup Converter (PMC) contains several design changes with respect to the Experimental Mockup Converter (EMC) design; they are: the thermoelectric couple configuration was optimized, the follower material was changed from aluminum hard-coated to beryllium oxide, and the interface dimensions were redefined which subsequently required additional measurement detail and variable data documentation. It is anticipated that the thermoelectric couple optimization will provide a converter efficiency greater than that which has been demonstrated previously in the EMC devices. Long-term testing of 10-couple modules 1 through 12 was continued, with statistical analysis made every 1000 hours on the data from modules 5 through 12. (auth)

51181 (SC-RR-68-528) RADIOACTIVE FUEL CAPSULE IMPACT DATA. Elkins, G. H. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1968. 52p. Dep. CFSTI.

Containment of the radioactive fuel in a radioisotope heat source (capsule) under impact conditions is an area of major concern in aerospace nuclear safety. During the past few years, a large number of impact tests of radioisotope capsules were conducted. A compilation of the data resulting from these tests is presented. The following parameters are presented for each impact test: impact velocity, capsule temperature at impact, impact angle, capsule failure or survival, target material, capsule description, capsule material, and source of data. Survival or failure of a specific capsule is as defined in the reference from which the data were obtained. (auth)

51182 COMPARISON OF LEAK TEST PROCEDURES FOR SEALED RADIUM SOURCES. Morris, Jerry O.; Menker, Donald F.; Dauer, Maxwell (Univ. of Miami, Florida). Amer. Ind. Hyg. Ass. J., 29: 279-84(May-June 1968).

A renewed interest in leak testing of sealed radium sources grew out of the 1959 amendment to the Atomic Energy Act. As more and more states assumed regulatory responsibility from the Atomic Energy Commission, the radium situation was brought into focus for the first time, as it, too, was licensed. Although the problem is much improved in these states, a lack of uniformity as to what constitutes a leaking source and the best method for detecting it still exists. Eight procedures for leak testing of sealed sources of radium were compared. They are charcoal, cotton plug, jar, radon film badge, radon scintillation probe, electrodeposition, wipe test, and direct readout. Sensitivity, reproducibility, and time requirements are discussed. The results are tabulated for easy comparison. (auth)

51183 THE RADIOPROTECTION QUALITIES OF VARIOUS β APPLICATORS. Born, W.; Geier, L. (Albert Ludwigs-Univ., Friedburg i.B.). Hautarzt, 17: 23-6(Jan. 1966). (In German).

The radioprotective properties of 2 types of planar $^{90}Sr-^{90}Y$ applicators were studied. In the first type the encapsulated source was faced with a 0.1-mm Ni plate, and in the other type the face plate consisted of 0.25-mm Al. Accumulated irradiation from the applicators was recorded on pen-type dosimeters. The irradiation dose from 10-mCi sources in Al ranged from 5 to 8.34 μR/hr of the theoretical therapy dose administered. A 20-mCi source in Al produced from 9 to 16.7 μR/hr. Sources of from 20 to 50 mCi contained in Ni produced from 3 to 3.2 μR/hr. The results indicated that applicators constructed of metals with the least possible at. no. offered no significant irradiation hazard to either the patient or medical personnel. Although the Al-enclosed sources produced fewer bremsstrahlung than did the ones enclosed with Ni, the total irradiation from the Al-enclosed sources was greater. Factors such as the different metal volumes of the applicators and purity of the metals used may have affected these results. (BBB)

51184 DIFFERENTIAL EQUATIONS FOR SPECIFIC ACTIVITIES IN A DISTRIBUTED TRACER SYSTEM. Hearon, John Z. (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Bull. Math. Biophys., 30: 325-31(June 1968).

The equations for establishing the quantity of a label and the specific activity in a spatially distributed diffusion-reaction system are described. In the case of Fick-law diffusion, the interfusion coefficient of Sheppard and Householder and an extension of the heat-flow analogy given by Sheppard are presented. Under the assumption of simple Fick-law diffusion with convection and/or imposed force fields, the flux law for labeled molecules in a tracer system was obtained. The partial differential equations for concentrations of tagged species and for activities in an open distributed reaction system are compared. (BBB)

51185 A COMPARISON OF METHODS FOR THE ASSAY OF MIXTURES OF ^{54}Mn AND ^{65}Zn. Haasbroek, F. J. (Fruit and Food Tech. Research Inst., Stellenbosch, S. Afr.). S. Afr. J. Agr. Sci., 9: 195-203(Mar. 1966).

A comparison was made of differential/differential, differential/integral, and integral/integral methods for the assay of mixtures of ^{54}Mn and ^{65}Zn. These methods consisted of combinations of differential, integral-discriminator, and integral measurements under plateau conditions using a well-type NaI(Tl) scintillation counter. The energy resolution for 0.662 MeV γ rays of ^{137}Cs was 14.5%, while the detecting efficiencies for ^{54}Mn and ^{65}Zn were 24.8 and 12.0%, respectively, under plateau conditions using 4 ml aliquots. The agreement between calculated and true counting rates was satisfactory if it was taken into account that the measurements were performed to a statistical accuracy varying from 1 to 3%. The ^{54}Mn readings were less accurate at high ^{65}Zn concentrations and this tendency agreed with the theoretically predicted deviations found. The ^{65}Zn readings, on the other hand, were only slightly affected by high ^{54}Mn concentrations. Although the differential/differential method appeared slightly less accurate than the other 2, the error curves were similar and no definite conclusions could be made. The methods also compared favorably with regard to the minimum total counting times required. The integral/integral method requires less complicated and expensive instruments since a normal integral counting arrangement can be used. The error formulae presented here enable a rapid comparison of methods and are also useful in determining the effect of varying isotope ratios. It was concluded that the differential/integral and integral/integral methods are preferable due to the advantages associated with integral measurements under plateau conditions. Convenient formulae were derived for the calculation of the statistical errors of individual components for various isotope ratios. (BBB)

51186 CHECKING GRINDING WHEELS BY MEANS OF MEASURING THE BACKSCATTERING OF β RAYS. Shonozaki, Tomonobu; Shigematsu, Hidemi (Kanazawa Univ., Japan). Seimitsu Kikai, 33: 580-6(Sept. 1967). (In Japanese).

Experiments on the β backscattering by grinding wheels are described. The amount of backscattering is changed considerably by the different kinds of wheels and conditions of wheel surface. The results obtained are as follows: the backscattering of β-rays corresponds to the respective grade of the five factors of the grinding wheel, leading to the possibility of checking the wheel by measuring the backscattering; and if the abrasive grain, bond and pore are distributed irregularly in the test wheel, the values of backscattering at the different places of the wheel surface, deviate remarkably from the mean value, but in the case of the uniform wheel, the values of backscattering are stable, therefore this measuring method can detect wheels of poor quality. (NSA of Japan)

51187 CONTRIBUTION TO THE COINCIDENCE METHOD FOR DIFFERENTIATING BETWEEN THE ACTIVITY OF LONG-LIVED EMITTERS AND THE ACTIVITY OF NATURAL RADIOACTIVE AEROSOLS. Starcuk, Zenon (Inst. of Instrumentation Tech., Brno). Jad. Energ., 14: 348-9(1968). (In Czech).

Data are given for a previous article on the coincidence method for differentiating between the activity of long-lived emitters and the activity of natural radioactive aerosols (published in Yaderna Energie 1967, 13, No. 1, p. 25). (R.V.J.)

51188 METHOD OF STUDYING THE PROPAGATION OF A PASSIVE IMPURITY IN CLOUDS BY MEANS OF RADIOACTIVE ISOTOPES. Shopauskas, K. K.; Gaivoronskii, I. I.; Styro, V. I.; (and others) (Inst. of Physics and Mathematics, Vilnyus, USSR). Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 4: 792-6(July 1968). (In Russian).

The propagation of ice crystals in a cloud was studied by injecting 1.8 mCi of ^{210}Po into the front and central part of a storm cloud by means of four rockets which were exploded within the cloud. In the same way a total of 70 mCi of ^{32}P was introduced into the central and rear of the cloud. These amounts of radioactivities were selected so as not to exceed the maximum allowable concentrations of radioactivities in the fallout samples which were collected over an area of ~1300 km^2 from a total of 230 stations. The samples were evaporated and counted. Ferric hydroxide was also used to scavenge the ^{32}P or ^{210}Po activity from the water sample. The data showed that the activity is not only propelled forward in the direction of motion of the cloud, but also to the side and to the back. A comparison of the data showed that the ^{210}Po spread out over a greater area than did the ^{32}P. This behavior may be ascribed to the fact that the isotopes were introduced into different parts of the cloud, or that they differ in their physical and chemical properties. This method can be used to study the removal of radioactivity from the atmosphere and the dynamics of motion in convective clouds. (TTT)

Materials Testing

Refer also to abstracts 51200, 51222, 52168, 52169, 52176, 52216, and 52258.

51189 (BNWL-727) ACOUSTIC EMISSION OF ZIRCALOY-2 DURING TENSILE AND FATIGUE LOADING. Michaels, T. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 30p. Dep. CFSTI.

The acoustic emission of Zircaloy-2 has been studied during tensile and fatigue loading at room temperature. A considerable amount of signal was received during these loading tests. Metallographic evidence relating acoustic emission to deformation processes was acquired. (auth)

51190 (BNWL-SA-1772(Pt.1)) RECENT NONDESTRUCTIVE TESTING ADVANCES AT BATTELLE-NORTHWEST LABORATORY. Worlton, D. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1, 1968. Contract AT(45-1)-1830. 8p. (CONF-680606-1). Dep. CFSTI.

From Symposium on Nondestructive Testing and Control in the Field of Nuclear Metallurgy and Technology, Saclay, France.

Acoustic emissions internally released in materials undergoing deformation or fracture may provide early warning of incipient failure of critical nuclear components, such as reactor pressure vessels or piping, during routine operations. A practical monitoring system based on this principle requires detection of acoustic emission signals against normal background noises, location of emission point of origin, characterization of failure or flaw growth mechanisms, and prediction of time of failure. Experimental data using this method to study crack propagation in large diameter steel pipe are presented. Further development work on the monitoring equipment and study of the relationship between emission signal characteristics and the irreversible metallurgical events which give rise to these signals is recommended. (L.C.L.)

51191 (LA-DC-9382) HIGH-TEMPERATURE EDDY-CURRENT CRACK DETECTION. Edenborough, N. B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 12p. (CONF-681004-2). Dep. CFSTI.

From 28th National Fall Conference of the American Society for Nondestructive Testing, Detroit, Mich.

A technique was developed to detect the time of cracking of samples representing atomic reactor components under high thermal gradients. An eddy current coil of tungsten–rhenium wire (W–26%Re) was wound on a specially machined boron nitride coil form. This coil operates at temperatures up to approximately 3200°F. This temperature was reached, from ambient, in 22 seconds. Special electronic circuitry was also developed to detect the small signal change caused by the cracking but ignoring the large changes caused by the quick heating. (auth)

51192 (LA-DC-9429) ON VARIOUS NONDESTRUCTIVE TESTING ACTIVITIES OF THE LOS ALAMOS SCIENTIFIC LABORATORY. Tenney, Gerold H.; Edenborough, Neville B.; Fullbright, H. J.; Gregory, T. G. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 12p. (CONF-680606-2). Dep. CFSTI.

From Symposium on Nondestructive Testing and Control in the Field of Nuclear Metallurgy and Technology, Saclay, France.

Some highlights of recent work in the field of nondestructive testing (NDT) are described: (1) eddy-current detection of cracking during thermal transients, (2) on-line data processing, and (3) replica inspection of narrow bore surfaces in tubes. The roles of NDT and a NDT engineer in industry are discussed. (D.L.C.)

51193 (SC-RR-68-132) FREE-FALL ROTATION AND AERODYNAMIC MOTION OF RECTANGULAR PLATES. Bustamante, A. C. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1968. 75p. Dep. CFSTI.

The aerodynamic motion of rectangular plates observed in 18 free-fall drop tests is analyzed and described. In most of the drops, the plates autorotated; the autorotation was independent of the plates' initial attitude. The autorotation generated a small lifting force which caused the plates to experience a gliding and spiraling motion. (auth)

51194 X-RAY INSPECTION OF NEUTRON IRRADIATED FUEL ELEMENTS WITH A BETATRON. Krautwedel, H. L.; Geithoff, D.; Enderlein, H. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 10: 494-8(Aug.-Sept.). (In English and German).

Metal-sheathed cylindrical UO_2 fuel elements are radiographed routinely in the hot cell facility of the Karlsruhe Nuclear Research Centre. The x-ray source used for these radiographs is an 18-MeV betatron. The experimental arrangement and procedures are briefly described. The evaluation of the radiographs obtained is illustrated by a few examples. The advantages of using a betatron for these examinations are discussed, and the importance of nondestructive testing of irradiated fuel elements is pointed out. (auth)

Protective Structures

51195 (ORNL-TM-2285) A COMPARISON OF THE BUILDING PROTECTION FACTOR CODES CAPS-2 AND PF-COMP. Final Report. Gritzner, M. L.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract DAHC20-67-W-0138. 62p. Dep. CFSTI.

Protection factors for various detector positions within five building designs of varying complexity were hand calculated. These results were then compared with machine-calculated protection factors using the PF-COMP and CAPS-2 programs. Program errors found in PF-COMP were corrected. The PF-COMP code was found to calculate protection factors in the 1 to 100 range for the five building designs to within ±15% of the hand-calculated values. The protection factors calculated with the CAPS-2 code tended to be high and were within −44 to +90% of the hand-calculated values. For protection factors above 100, the PF-COMP code gave results that were within −41 to +36% of the hand-calculated values and tended to be conservative. In contrast, CAPS-2 results were generally not conservative, with the percentage error ranging from −10 to +58%. Based on these calculations, along with the relative ease with which the PF-COMP code may be used for multiple-story calculations, the PF-COMP is deemed the better code and the use of CAPS-2 should be restricted to calculating structures with low protection factors (about 20 or less) and/or of only limited complexity. (auth)

51196 INCORPORATION OF SHOCK PROTECTION IN EXISTING ABOVEGROUND CYLINDRICAL STRUCTURES SUBJECTED TO NUCLEAR BLAST. Cohen, E.; Weissman, S.; Sanchez, L. Shock Vib. Bull., 37: 213-21(Jan. 1968).

The contents of existing small-diameter, aboveground, multistory cylindrical structures, housing equipment and personnel, will be provided with shock protection consistent with the blast capacity (10 to 50 psi for megaton weapon yields) of the concrete structural shell. Large horizontal and rotational motions, in addition to vertical motions, will occur in the cylinder because of its configuration and flexibility. In the development of appropriate shock-mounting schemes, every interior component and system was investigated to determine where shock protection was required to assure the survival and postattack operation of all essential electronic components and key personnel. Many restrictions were imposed by the requirement for incorporating shock isolation within small, confined areas in which the equipment requiring protection is already installed. Vertical, horizontal, and rotational shock response spectra at each floor level were used as input to design various shock protection schemes to meet shock tolerance and fragility criteria. Typical designs illustrated and discussed include spring-suspended group platforms to protect sensitive electronic equipment and personnel operating this equipment, individual spring-mounted service equipment such as air conditioners and electric panel boxes, rigid-mounted items such as fire extinguishers and tools, rugged replacements including stronger partition walls and metal toilet units, additional clamps and supports for piping, and flexible utility and power lines connected to spring-mounted equipment, and energy-absorbing padding. (App. Mech. Rev.)

51197 DYNAMIC ANALYSIS OF A TYPICAL ELECTRONIC EQUIPMENT CABINET SUBJECTED TO NUCLEAR-WEAPON-INDUCED SHOCK. Putukian, J. H. Shock Vib. Bull., 37: 97-101(Jan. 1968).

The response of sensitive electronic components housed in equipment cabinets on the third floor of a steel-framed structure to nuclear weapon effects was analytically determined. The objective of the investigation was to generate a structural design criterion for the electronic components. Computer storage capability was the controlling consideration in generating the mathematical models. The analysis had to be done in steps such as going from the ground for ground shock, and the roof for air blast, to the third floor column lines, from the column lines to the black boxes considered as rigid bodies, and finally from the response of the black boxes to the components. It is shown that this approximate analysis using the modal superposition method gives satisfactory results. The parametric considerations affecting this analysis are discussed. (App. Mech. Rev.)

Radioactive Material Handling

Refer also to abstracts 51121, 51132, 51142, 51143, 51150, and 53395.

51198 (AERE-M-2086) USE OF MASSIVE FOAMED POLYSTYRENE IN RADIOACTIVE TRANSPORT PACKAGING. Dixon, F. E.; Olley, F. K.; Cohen, L. R. (Atomic Energy Research

Establishment, Harwell (England)). July 1968. 17p. Dep. CFSTI. UK 7s. 0d.

An account is given of the use of thick foamed polystyrene as a replacement for fibreboard packaging, steel spiders and wooden spiders, and its use with tinplate drums and as space shielding in cork insulated type B packages. Results of tests on packagings to carry lead pots up to 50 lbs in weight are described. (auth)

51199 (BNL–11915) A NUCLEAR TRANSFORMATION SYSTEM FOR DISPOSAL OF LONG-LIVED FISSION PRODUCT WASTE IN AN EXPANDING NUCLEAR POWER ECONOMY. Gregory, Michael V.; Steinberg, Meyer (Brookhaven National Lab., Upton, N. Y.). Nov. 1967. 76p. (CONF-680601–37). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

A system is presented wherein long-lived fission waste products resulting from spent nuclear power reactor fuel are safely and permanently disposed of by a nuclear transformation reaction technique. The long-lived fission nuclei, mainly ^{137}Cs and ^{90}Sr, are placed in a region of high neutron flux. Upon capturing a neutron, the long-lived nucleus is transformed into a short-lived one which subsequently decays to a stable and innocuous product. The high flux is generated in a nuclear spallation reaction (p,xn) occurring in a liquid heavy-metal target struck by a high-energy proton beam. The fission product transformation (FPT) complex consists of a nuclear power reactor delivering electrical power to a high-energy proton accelerator which feeds a proton beam to a spallation reactor wherein the nuclear transformation reactions take place. The long-lived fission products ^{137}Cs and ^{90}Sr are separated and concentrated in a nuclear fuel reprocessing plant after appropriate storage and decay of the shorter-lived waste products. The problems considered are the design of the spallation reactor, the design of the fission product waste "blankets," heat transfer problems in a liquid metal spallation target "core," containment of the liquid metal, the neutronics of flux depression, reprocess cycling schemes, and the cost of the system. It is estimated that for a nuclear power economy of 150,000 MW(e), which could be reached by the year 1980, a high-energy accelerator, with a proton beam power in the range of 650 to 880 MW and with an energy in the 1 to 10-BeV region yielding an effective flux of 2×10^{17} n/cm^2-sec in the spallation reactor, would dispose of all the fission product waste ^{137}Cs and ^{90}Sr produced by the power economy. A 1300-MW(e) nuclear reactor is required to power the entire complex. These values are primarily based on limiting the activity in the spallation reactor to no more than that in a 1000-MW(e) reactor after long-term power operation; a larger inventory would reduce power and beam energy requirements. A liquid uranium target-coolant system is proposed upon which a rough preliminary cost estimate is based. A unit charge of 0.036 mills per kWh(e) of power produced in the economy is estimated for the operation, which includes 4½% depreciation on the investment. This is ≈1 to 2% of the total production cost of nuclear power generation. An alternative liquid bismuth–lead eutectic coolant-target is also discussed, since this system offers operating temperatures an order of magnitude less severe than those of the liquid uranium system, as far as the containment problem is concerned. Its cost to the economy is found to be 0.077 mills per kWh(e). Both systems appear attractive, since they offer a positive means to reduce the amount of long-lived fission product waste accumulated at a cost comparable with the present estimated costs of the somewhat dubious perpetual storage schemes proposed heretofore. Although this is an advanced concept, the advancing technology in high-energy accelerators and in liquid metal handling allows practical consideration of this nuclear transformation technique for further intensive development. (auth)

51200 (CEA-R–3372) TESTS OF TYPE B RADIOACTIVE MATERIAL PACKING. THEORETICAL STUDY OF DEFORMATION OF A CYLINDRICAL CONTAINER AFTER A FALL. Cally, Jean-Claude; Formery, Philippe; Labrousse, Michel (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1968. 46p. (In French). Dep.

The packings used for transporting highly radioactive materials, e.g., irradiated fuels are usually made of two steel shells with lead in the space between. These packings are subjected to fairly strict safety regulations. In particular, they have to withstand a fall of 9 m without any of their contents being dispersed and without the radioactive protection being seriously affected. The study was an attempt to define the factors for representing the deformation, and to determine the impact shock damage resulting from a fall. (auth)

51201 (ORNL-tr–1973) SITE STUDY FOR THE STORAGE OF RADIOACTIVE WASTES IN THE EUROPEAN COMMUNITY. Grison, G.; Krause, H.; Leveque, P. Ch.; Pantanetti, F. (European Atomic Energy Community). Translated for Oak Ridge National Lab., Tenn., from report EUR–3664. 82p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 25628. (R.C.K.)

51202 (SZS–9/68) EXPERIMENTAL REPORT ON THE DECONTAMINATION OF RADIOACTIVE WASTES OF THE INSTITUTE FOR APPLIED RADIOACTIVITY ACCORDING TO THE PRECIPITATION METHOD. USE OF KIESELGUHR, MULTICLONE POWDERS, AND SEVERAL OTHER ADSORBANTS FOR DECONTAMINATION OF WASTE CONTAINING ^{137}Cs AND $^{90}Sr/^{90}Y$. A SIMPLE METHOD FOR PURIFICATION OF ^{60}Co-CONTAMINATED REACTOR WASTE. Otto, R.; Hecht, P.; Bosholm, J.; Sachse, G.; Schlenkrich, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1968. 33p. (In German). Dep.

Three papers are included on equipment and methods for decontamination of radioactive wastes prior to disposal. A separate abstract was prepared for each paper. (R.C.K.)

For abstracts of individual papers see: 51203–51205.

51203 (SZS–9/68, pp 1-12) EXPERIMENTAL REPORT ON THE DECONTAMINATION OF RADIOACTIVE WASTES OF THE INSTITUTE FOR APPLIED RADIOACTIVITY ACCORDING TO THE PRECIPITATION METHOD. Otto, R.; Hecht, P. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). (In German).

The construction of the discontinuous purification plant for radioactive waste installed in the Institute of Applied Radioactivity is described. The experience gathered during the five years-operation of the plant is also outlined. The decontamination takes place by addition of $CaCl_2$, $Fe_2(SO_4)_3$, Na_3PO_4 and following flocculation at pH 10 to 11. Precipitation of FeS must be performed. By this method up to 99% of the radioactivity is removed. The plant satisfies the special demands placed upon it. (auth)

51204 (SZS–9/68, pp 14-25) USE OF KIESELGUHR, MULTICLONE POWDERS, AND SEVERAL OTHER ADSORBANTS FOR DECONTAMINATION OF WASTE CONTAINING ^{137}Cs AND $^{90}Sr/^{90}Y$. Otto, R.; Hecht, P. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). (In German).

Studies regarding the use of kieselguhr, multicyclone dust, ash of brown coal, whitewash and hydrated lime for decontamination of laboratory waste containing ^{137}Cs and $^{90}Sr/^{90}Y$. Model water systems were either filtered through a layer of the adsorbents or stirred with the adsorbents. An efficiency up to 99.9% was obtained, depending on the applied adsorbent, on the amount of foreign matter in the water, and in some systems on the admixture of auxiliary chemicals. (auth)

51205 (SZS–9/68, pp 27-33) A SIMPLE METHOD FOR PURIFICATION OF ^{60}Co-CONTAMINATED REACTOR WASTE. Bosholm, J.; Sachse, G.; Schlenkrich, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). (In German).

A method for treatment of more than 300,000 l waste water, mainly contaminated with ^{60}Co is described. Several methods of decontamination were investigated on a laboratory scale. The results are presented. The treatment with prepared iron filings proved to be the simplest method and was the most efficient. So far about 200,000 l of reactor waste water were pretreated with a 1,000 l Fe filter, so that after dilution a discharge was possible. Some experience with this filter as well as the decontamination efficiency of the filter are described in detail. (auth)

51206 (UCRL–14903(Rev.1)) AN IMPROVED SHIPPING CONTAINER FOR FISSILE MATERIAL. Gaskill, James R.; Taylor, Robert D. (California Univ., Livermore. Lawrence Radiation Lab.). July 24, 1968. Contract W-7405-eng-48. 31p. Dep. CFSTI.

Based on an ORNL design, an improved shipping container for fissile materials has been developed. This container has passed the normal and accident tests proposed in the current revision of AEC Safety Standards. Further, a criticality analysis by the LRL Criticality Safety Advisory Group has established quantitative limits for shipping solid forms of enriched uranium and plutonium according to AEC criteria for Class I, Class II, and Class III categories. Tests made on simulated quantities of fissile material indicate the degree of internal heat buildup that can be expected in this container. (auth)

51207 (Y-DD–19) EVALUATION OF THE M-101 AND M-102 SHIPPING CONTAINERS IN VERMICULITE-FILLED 55-GALLON DRUMS. Handley, G. R.; Crume, E. C.; Mee, W. T. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Aug. 26, 1968. Contract W-7405-eng-26. 35p. Dep. CFSTI.

M-101 and M-102 shipping containers packed in drums filled with vermiculite were evaluated against the fissile material packaging requirements given in AEC Manual Chapter 0529 for the

shipment of uranium metal and dry uranium compounds at any enrichment in the ^{235}U isotope. Based on the results of an engineering analysis, mechanical testing of containers, and an associated nuclear criticality safety analysis, the container was found to satisfy the requirements of Chapter 0529 as follows: for Fissile Class II shipments, each container may be loaded with up to 19.0 kg ^{235}U in uranium metal or with up to 25.5 kg ^{235}U in a dry uranium compound with a density of 4.5 g/cm^3 or less. These compounds must have an H/^{235}U atomic ratio less than 2. A shipping container loaded so as to satisfy these restrictions is to be assigned 0.5 transport units; and a Fissile Class III shipment may consist of up to 202 containers loaded as for Class II. (auth)

51208 MOVEMENT THROUGH SOIL OF RADIOACTIVE NUCLIDES CONTAINED IN CHEMICAL PROCESSING WASTE. Iwai, Shigehisa (Kyoto Univ.); Inoue, Yoriteru; Nishimaki, Kenzo. Nippon Genshiryoku Gakkaishi, 10: 435-40(Aug. 1968). (In Japanese).

The movement through soil of radioactive nuclides contained in chemical processing waste was investigated. Theories governing this movement were reviewed. Experiments were carried out with ^{90}Sr and ^{137}Cs in 1$\underline{N}$-HNO_3 to simulate waste. This simulated waste was passed through a column packed with sand and the behavior of these radionuclides in the column was observed. The breakthrough curve of ^{90}Sr was very similar to the curve of the waste, while ^{137}Cs showed a curve about 60 times slower than the waste. It can thus be concluded that ^{90}Sr in actual wastes travels with the ground water, while ^{137}Cs moves about 60 times slower. (auth)

51209 RADIOACTIVE-WASTE TREATMENT FACILITIES. Kadoya, Shozo; Nomi, Mitsuhiko (Ebara Mfg. Co., Ltd., Japan). Ehara Jiho, 16: No. 63, 112-17(Sept. 1967). (In Japanese).

Design and construction of radioactive waste treatment facilities are described. Radioactive waste treatment facilities are discussed in the following sections: medium-level liquid waste treatment facilities; low-level liquid waste treatment facilities; radioactive liquid-waste treatment facilities in the JAPC Tokai power station; incinerators for treatment of solid radioactive wastes; and research and development activities. (NSA of Japan)

51210 IMPROVED SPENT-FUEL TRANSPORT CONTAINER. Sawai, Sadamu (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-10960. May 8, 1968. Filed Sept. 8, 1965.

A spent fuel transport container is described that is protected against fire and shock. The transport container, consisting of the shield, inner containing space, plug, etc., is surrounded outside the top and bottom and outside the sides by two parallel plates. The two plates are held together with space between by means of ribs, the inner plate is held to the outside surface of the container also by ribs, and the top and bottom of the many spaces produced between the plates are closed with plates having holes. By this means, the heat from a fire and accidental shocks given to the container can be considerably absorbed before reaching the container itself. (NSA of Japan)

51211 SYSTEM FOR INTERCONNECTING TWO HERMETIC-ENCLOSURES DISPOSED OPPOSITE ONE ANOTHER. Lefrancois, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,129,509. Oct. 9, 1968. Priority date Apr. 6, 1966, France.

A method for interconnecting two hermetically sealed enclosures, such as hot cells, placed opposite to each other is described. This system is useful in transferring neutron sources from one enclosure to the other and consists of an inclined tube extending through adjacent walls. The tube has one end in a basin of liquid and extends below the level of a volume of liquid in the second enclosure. The liquids at the tube ends supply sealing for the enclosures. The neutron source is transferred by gravity. (F.S.)

51212 IMPROVEMENTS IN/OR RELATING TO SYSTEMS FOR INTRODUCING OR REMOVING APPARATUSES, IN PARTICULAR MUFFLES, INTENDED TO OPERATE IN RADIOACTIVE ENCLOSURES. (to Commissariat a l'Energie Atomique). British Patent 1,130,681. Oct. 16, 1968. Priority date Aug. 4, 1966, France.

A system for safe, easy, and rapid manipulation of apparatus, such as the muffle of a furnace, which is operated in a shielded enclosure or hot cell, is described. The system consists of a shielded body or flask in which a part of the apparatus to be replaced or removed is located. The flask is brought to an opening in the wall or top of the enclosure. The base of the shielded body or flask is fitted with a controlled trap door in the form of a drawer. A second trap door drawer is coupled to the first. (F.S.)

51213 AUXILIARY TONGS FOR A POWER-DRIVEN MANIPULATOR. Hagiya, Miyoshi (to Hitachi Ltd.). Japanese Patent 1968-10719. May 9, 1968. Filed June 22, 1964.

Auxiliary tongs are described that can easily be fixed to the main tongs of a power-driven manipulator; and using these tongs radioactive materials can be easily removed from narrow vessels. The auxiliary tongs can be opened or closed by a pantograph using pins and links, and the whole is fixed to the main tongs through the base. (NSA of Japan)

51214 CARRIER FOR TRANSPORTATION OF RADIOACTIVE MATERIALS. Bonnet, Georges; Mollica, Guido; Bottani, Giuseppe (to EURATOM). British Patent 1,130,762. Oct. 16, 1968. Priority date May 18, 1965, Belgium.

A shipping container for radioactive materials is described which is protected against damage from fire or impact. The thick lead-lined container has external cooling fins and a strong casing or box which is insulated on the tops and sides. The box is spaced away from the container to allow space for flow of cooling air. Exit air holes are provided with temperature responsive means for closure in case of fire. (F.S.)

51215 DEVICE FOR LIFTING OBJECTS. Raven, Anthony David (to English Electric Co., Ltd.). British Patent 1,130,928. Oct. 16, 1968. Filed Sept. 17, 1966.

A device is described for gripping objects while lifting or lowering them which has a number of loose balls arranged to project from the sides. Such an object could be a reactor control rod. The device includes a plunger and an electromagnet. The plunger is arranged so as to engage and lock the balls in one position and to retract them in a second position while the electromagnet is lifting or lowering the control rod. (F.S.)

51216 MANIPULATOR. Hagiwara, Satoru (to Mitsubishi Electric Mfg. Co.). Japanese Patent 1968-13840. June 12, 1968. Filed Dec. 30, 1965.

A manipulator is described that is used for handling material in a cell, with a grabbing device fixed at the end of a manipulator within the cell that can stay at a certain position without moving. Three steel tapes, two for the wrist control and one for grabbing, run through the manipulator pipe from the master to the slave. To hold the former two tapes so that they will not travel through the pipe, a means is provided in the part of the pipe outside the cell wall. It consists of a short square pipe through which the three tapes run, and a metal piece within the square pipe which holds the two tapes against the back wall of the square pipe by means of a bolt attached to the metal piece. (NSA of Japan)

51217 PILOT PLANTS: RADIOACTIVE MATERIALS IN PILOT PLANTS. Black, D. E.; Horn, S. J. (Idaho Nuclear Corp., Idaho Falls). Chem. Eng. Progr., 64: No. 10, 43-9(Oct. 1968).

The safe use of radioactive materials in industry is discussed. Though safe operation with radioactive materials does not require development of a new technology, intelligent application of existing operating procedures and implementation of special precautions are required. Adherence to established limits of radiation exposure and material releases to the environment is mandatory. Administrative methods and physical controls have been developed and used at the ICPP and other AEC laboratories with success and can be adapted for use in most pilot plants. However, each individual process must be examined carefully when the use of radioactive materials is being considered. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 51260, 51276, 51567, 51665, 51812, 51821, 51856, 53452, 53485, and 53488.

51218 (AD-672313) CALCULATED SPECIFIC YIELD FUNCTIONS FOR NEUTRON MONITORS. Final Report, May 15, 1967-May 14, 1968. Wainio, Kendle M.; Colvin, Theodore H.; More, Keith A.; Riffany, Otho L. (Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.). June 15, 1968. Contract F19628-67-C-0367. 40p. (BSR-2302; AFCRL-68-0320). CFSTI.

Results of calculations to determine specific yield functions for IGY neutron monitors are reported for vertically incident protons in the range of 0.5 to 3 GeV/c. The Monte Carlo method is used to calculate secondary nucleon flux intensities at various depths in the atmosphere. Experimental data on neutron monitor response are employed to relate the calculated flux data to count rates and hence to specific yields. The specific yield function was also calculated as a function of the angle of incidence of the primary cosmic ray flux. The results show that a significant fraction of counts in a neutron monitor is produced by particles incident from directions other than the vertical. (auth) (USGRDR)

51219 (AD-672474) SELF-POWERED RADIAC INSTRUMENTATION. Vogel, E. Michael (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). May 1968. 18p. (NDL-TM-42). CFSTI.

Self-powered and low-powered solid-state electronic techniques were used to investigate the feasibility of satisfying military radiac instrumentation requirements. The development of a prototype integrated radiac instrument, based on a scintillator-photovoltaic cell concept, is proposed. The crucial parameters of the candidate components for the proposed instrument are discussed. This instrument would be capable of measuring gamma radiation from 10 to 1000 R/h in a self-powered mode, and from 10 mR to 10 R/h in a low external powered mode; the instrument would also function as a dosimeter. (auth) (USGRDR)

51220 (IAE-1453) NUVISTOR PREAMPLIFIER FOR WORK WITH SEMICONDUCTOR DETECTORS. Rodionov, Yu. F.; Shiryaev, F. S. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1967. 8p. (In Russian). Dep.

A low-noise charge preamplifier based on metalloceramic nuvistor tubes has been developed for work with semiconductor radiation detectors. Electrical and wiring diagrams are presented, and operating characteristics are given. The noise level of the amplifier is $\simeq 2.1 \pm 0.4$ C (input/output). (tr-auth)

51221 (NYO-841-13) LOW-LEVEL MONITORING OF ^{85}Kr IN AIR. EVALUATION OF ACTIVATED CARBON AND ELECTROSTATIC DIFFUSION AS CONCENTRATING MECHANISMS. Reist, P. C.; Smith, D. G. (Harvard Univ., Boston, Mass. Harvard Air Cleaning Lab.). Aug. 1968. Contract AT(30-1)-841. 39p. Dep. CFSTI.

Adsorption of krypton-85 on activated carbon at -78.5°C followed by desorption at 20°C into a 2.8 liter ionization chamber coupled to a vibrating reed electrometer will permit laboratory measurements down to concentrations of 10^{-9} μCi/cc. Within the range of the experimental concentrations used, it was observed that the concentration factor for a given adsorption bed is independent of the ^{85}Kr in the air being sampled; for maximum concentration it is best to permit adsorption to reach equilibrium (i.e., to proceed past the breakthrough point), and concentrations of ^{222}Rn normally present in air can produce significant measurement errors particularly at low concentrations. However, by equipping monitoring systems with special adsorption units for removing this component (and radioactive xenon, if necessary) prior to processing the ^{85}Kr sample, this interference can be eliminated. A supplementary investigation of the use of electrostatic diffusion as a concentrating mechanism for ^{85}Kr proved unsuccessful. (auth)

51222 (TID-24730) MONTHLY REPORT NO. 2. Berger, Harold (Argonne National Lab., Ill.). Sept. 1968. 10p. Dep. CFSTI.

The research program which will be carried out at the Center d'Etudes Nucleaires de Grenoble (CENG) which is a study of image detection methods for fast neutron radiography is described. Accelerator and radioisotope neutron sources are considered, and various detection systems are discussed including x-ray fluorescent screens and x-ray films, scintillation counters, threshold detectors, and track-etch detectors. (W.H.K.)

51223 COSMIC RAY TELESCOPE (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1772).

5 drawings.

A fluorescer-photomultiplier cosmic ray telescope used to obtain cosmic ray equator points and to examine the vertical cosmic ray intensity at atmospheric depths of 200 to 250 g/cm^2 is described. Total power requirements are 800 W using a 105 to 125 V, 60 cps ac supply with sufficient cooling for electrons provided by built-in fans. (For details see TID-4100 Suppl. 48; see also 22: 37996.) (F.S.)

51224 INFLUENCE OF THE AFTER-PULSES OF PHOTOMULTIPLIER TUBES IN LIQUID SCINTILLATION COUNTING. Friedrich, K.; Leistner, M. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Isotopenpraxis, 4: 251-5(July 1968). (In German).

The influence of the after-pulses on liquid scintillation counting as a function of various parameters was studied for some specimens of the photomultipliers of S 12 FS 35 type (manufacturer: VEB Carl Zeiss Jena). These investigations result in practical hints for meeting false measurements due to the after-pulses, which should unconditionally be considered in absolute measurements of activity by liquid scintillation counters. (auth)

51225 ADAPTATION OF THE TIME-TO-AMPLITUDE CONVERTER TO TIME MEASUREMENTS WITH THE USE OF SEMICONDUCTOR RADIATION DETECTORS. Moszynski, Marek (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 13: 931-9(1968).

The adaptation of time-to-amplitude converter in cooperation with semiconductor detectors is presented with regard to the possibility of measurements of detector time spreads and of coincidence measurements in nuclear spectroscopy. Coincidence curves using scintillation counter and Si(Li) or Ge(Li) detector are shown. (auth)

51226 EFFECT OF OXYGEN AND HUMIDITY ON CHARGED PARTICLE REGISTRATION IN ORGANIC FOILS. Becker, K. (Oak Ridge National Lab., Tenn.). Radiat. Res., 36: 107-18 (1968).

The number and diameter of microscopically visible alpha-particle tracks which can be etched in the surface of sensitive plastic foils such as cellulose triacetate are increased by the presence of oxygen. Pre- or posttreatment of foils with water or humid air increases the etching speed but not the foils' sensitivity. Treatment of foils with diluted H_2O_2 increases the sensitivity slightly, but the etching speed considerably. Some parameters of the oxygen/humidity effect are described; its possible consequences for the interpretation of the latent track formation process and its practical applications are discussed briefly. (auth)

51227 2π-BETA-SCINTILLATION DETECTOR FOR MEASURING LOW ACTIVITIES WITH THIN PLASTIC SCINTILLATORS. Dimchev, T.; Beleva, E. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 21: 633-6(1968).

The performance of a 2π-beta scintillation detector consisting of a thin plastic scintillator, platinum reflector, and a low-noise photomultiplier is described. (W.H.K.)

51228 MEASUREMENT OF TRITIUM YIELDS FROM TITANIUM-TRITIUM TARGETS AS WELL AS DETERMINATION OF THE TRITIUM CONTENT OF THE AIR BY LIQUID SCINTILLATORS. Svoboda, Robert. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 176: No. 3, 93-111(1967). (In German).

Two methods for the determination of the tritium content of the air with liquid scintillators were developed. In the twirl method the air to be studied was blown through the scintillator, and its activity gave an order-of-magnitude value for the tritium content of the air. The sensitivity of this method for tritium gas and active moisture varies by the same factor as the absorbing capacity of these two components in man. The twirl method represents one, although inaccurate, measurement of the toxicity of any mixture of tritium and moisture in air. About 0.2 μC/m^3 of active air moisture can be detected in 20 min total measurement time. In the freezing method, active air moisture is collected directly and tritium gas is collected after oxidation by freezing. The fraction of gas and moisture is measured separately. A sensitivity of 4×10^{-3} μC/m^3 of tritium in air can be attained with total measurement time of 40 min. Using the freezing method, the tritium yield of titanium-tritium targets was investigated in some detail. It is shown that these targets yield their activity at 99.5% in the form of active moisture and 0.5%

in the form of tritium gas. An explanation of the oxidation of the escaping tritium as a surface effect at the target is proposed. The total tritium yield in a 1.2 C target was about 0.3 μC/hr. The placement of these targets in a dessicator decreases the tritium yield to the air considerably. (tr-auth)

51229 PROGRAM FOR QUENCHING CORRECTIONS IN LIQUID SCINTILLATION COUNTING. Winkler, K. (Institut fuer Physikalische Chemie, Berlin); Wockenfuss, H.; Siegler, K.; Zipperer, K. Isotopenpraxis, 4: 187-9(May 1968). (In German).

An ALGOL program for the calculation of corrections of ^{14}C measurements was developed. The program is presented. (J.S.R.)

51230 TECHNIQUES FOR SUPPRESSING ANOMALOUS RESPONSE TO VACUUM ULTRAVIOLET RADIATION IN THE CHARGED-PARTICLE LUNAR ENVIRONMENT EXPERIMENT. Ferguson, L. D.; Pfeifer, J. L.; Johnson, M. C.; Wolber, W. G. Bendix Tech. J., 1: 89-92(Spring 1968).

One Apollo lunar experiment will measure the electron and proton flux of the solar wind in 2 directions aligned with respect to the lunar poles by a pair of energy analyzers. This required reconsideration of instrument design, particularly with respect to the effects of the intense solar flux during the lunar day. The instrument's energy analyzer assembly is illustrated. Electrons and protons are electrostatically deflected by plates such that 5 energy bands are selected by a line array of 5 Channeltron electron multiplier detectors. The plate potentials are stepped and reversed to sort both electron and proton energy bands. A sixth funnel-shaped detector, mounted on the other side of the analyzer, detects protons when the main analyzer is sorting electron energies, and vice versa. The analyzer response due to extreme uv radiation had to be lowered by a factor of 10^9 from the detector response to direct sunlight, for the lower part of the electron–proton range to be useful. Attempts to trap the direct uv radiation in a blackbody cavity reduced the radiation scattering but the photoelectron production persisted. To suppress direct extreme uv radiation, it was found that better analyzer slits were required; an edge formed by stainless-steel razor blades was found to be superior. Now, the major source of the spurious counts remaining was stray photoelectrons produced near the analyzer plates. All the sidewalls and baffles and the uv trap were biased +45 V with respect to the detector input, further reducing the spurious count rate. All these techniques were incorporated into the design of the energy analyzer and their joint effect experimentally determined. Remaining spurious counts appeared to be from photoelectrons produced near the negative deflection plate when it was switched to the high-negative-voltage (high-energy) range. (BBB)

51231 SEMICONDUCTOR COUNTERS FOR NEUTRON MEASUREMENTS. Ruge, I.; Eichinger, P. (Technische Hochschule, Munich). Kerntechnik, 10: 478-83(Aug.-Sept. 1968). (In English and German).

Silicon p–n and p–i–n junctions are used successfully for measuring fast neutron fluences, and also in dosimetry. By monitoring the changes in the forward resistance, the photocurrent, or the recovery time of these junctions, it is possible to cover a range from 0 to 15,000 rad (fission neutrons). Combinations of neutron converter foils with silicon surface barrier detectors, in which the detectors register the energy of the fast particles formed by neutron reactions in the converter, are suitable for neutron spectroscopy and the neutron flux density measurements. So far, however, there are no semiconductor detectors possessing the combination of high temperature performance and of resistance against irradiation damage required for neutron flux density probes for in-core use. (auth)

51232 A STABLE, LOW-BACKGROUND WHOLE-BODY COUNTER DESIGNED FOR UNIFORM DETECTOR GEOMETRY. Ross, D. A.; Morris, A. G. (Oak Ridge Inst. of Nuclear Studies, Tenn.). Int. J. Appl. Radiat. Isotop., 19: 731-9(Oct. 1968).

The whole-body counter describes uses earth, plus massive walls made of carefully selected materials, to shield the detector array from the relatively high levels of radiation that are sometimes generated in an adjoining hospital. The innermost lining of the counting chamber (cave) is hermetically sealed to block the entry of radon. Operating procedures are designed to prevent contamination of the cave. The subject reaches the counting location without tracking in radioactive dust, and no one else enters the cave. Ventilation air is conditioned and carefully filtered; the ventilated compartment is small, to minimize the required air flow, and the remaining volume of the cave (92%) is unventilated. A multiple-detector array provides nearly uniform sensitivity throughout the volume to be occupied by the subject. The detectors and all other equipment installed in the cave were very carefully screened for inherent radioactivity. The adjoining clean laboratory is a restricted area entered only by the operator and the subjects. The precautions taken have produced gratifying performance. The background is one of the lowest on record, and is wholly independent of other activities in the hospital, including cobalt-60 teletherapy. With such a background the detectors' sensitivity permits the measurement of normal adult body burdens of cesium-137 and potassium-40 with a counting time of 20 min and statistical standard deviations of well under 5%. (auth)

51233 CORRELATION OF SIMULTANEOUS ^3H AND ^{14}C AUTORADIOGRAPHY WITH GAS COUNTING. Vesely, J.; Tykva, R. (Inst. of Organic Chemistry and Biochemistry, Prague). Int. J. Appl. Radiat. Isotop., 19: 705-7(Sept. 1968).

The possibility of using a single layer of stripping film for the simultaneous detection of ^3H and ^{14}C and to correlate grain counting with the radioactivity of cells labeled with ^3H or/and ^{14}C was studied. The experiments were conducted with thymidine-U-^3H and thymidine-7-^{14}C in leukemic rats (in vivo). Radioactivities of cell suspensions were determined by means of an internal proportional gas counter. Autoradiographic and gas counting determinations of ^3H and ^{14}C radioactivity are tabulated. It was found that the specific radioactivity was distinctly higher after administration of ^3H, while the synthetic indices (fraction of labeled cells multiplied by number of grains per average labeled cell) determined by autoradiography were increased after ^{14}C administration. Determination of the specific radioactivity of mixed ^3H and ^{14}C labeled cells showed that the deviation from the assumed 50% decline for both radionuclides did not exceed ±10%. Autoradiographic values were less consistent. Results indicated that the autoradiographic differentiation of ^3H and ^{14}C labeled cells in a given population using a single layer of stripping film is, in contrast to grain counting, rather accurate. This was verified by measuring the DNA synthetic period of leukemic lymphoblasts in mice in vivo by administering thymidine-^3H and -^{14}C. (UK)

51234 METHOD OF CONFIRMING THE UNIFORMITY OF SPECTRAL CHARACTERISTICS OF SECOND- AND THIRD-CLASS ALPHA SOURCES DURING CALIBRATION. Konstantinov, A. A.; Alekseev, V. Ya.; Karmalitsyn, N. I. Izmer. Tekh., No. 9, 75-7(Sept. 1968). (In Russian).

The calibration method depends on the fact that the absorption ability of a substance is a function of the energy of the alpha particle. On passage of an alpha particle through a substance, the energy loss increases with decreasing energy of the alpha particle. The relative change in count rate for two sources (with an absorber and without an absorber) is determined at the same geometry on a ZnS alpha counter. The absolute value of the relative change in count rate S is greater, the more strongly the spectral characteristics of the two sources being compared differ from each other. A set of six ^{239}Pu sources covered with an organic film having a thickness of 1, 2, 3, 4 and 5 g/m^2 was used in calibrating the equipment. By this method it was found that the average energy of alpha particles was 5480 keV, a value in good agreement with that obtained by measurement on a magnetic spectrometer. The resolution was 0.25%. (TTT)

51235 A COMPARISON OF THE METHODS FOR THE DETERMINATION OF THE COINCIDENCE RESOLVING TIME IN COINCIDENCE EQUIPMENTS USED FOR DISINTEGRATION RATE MEASUREMENTS OF RADIOACTIVE SOURCES. Schoenfeld, E. (Deutsches Amt fuer Messwesen und Warenpruefung, Berlin). Int. J. Appl. Radiat. Isotop., 19: 747-51(Oct. 1968). (In German).

Methods are reviewed for determining the coincidence resolving time of coincidence instruments which serve for the determination of the disintegration rates of radioactive sources. For a special instrument, details of which are given, the coincidence resolving time is determined from observations with an oscilloscope, with a double pulse generator, by counting of accidental coincidences after destroying the true ones with a delay line, and by counting of accidental coincidences with two sources (sufficiently separated in space). From the observed values (950 ± 50) ns, (940 ± 6) ns, (946 ± 6) ns, and (943 ± 6) ns resp. it can be that these methods give the same results within the limits of error, and are of equal worth. The parameters which influence the sharpness of definition of the coincidence resolving time, and the precision nowadays attainable with simple means in determining the coincidence resolving time, are discussed. (auth)

51236 IZMERENIE TRITIYA. (Measurements of Tritium). Lomonosov, I. I.; Soshin, L. D. Moscow, Atomizdat, 1968. 108p.

The methods for the measurement of the activity of tritium and of tritium-labeled compounds are described. Tritium as a label has a wide range of applicability, especially in the fields of experimental biology and medicine. However, the use of tritium is limited by difficulties in the registration of its radioactivity. Ionization and scintillation methods for the measurement of the tritium activity are presented. Particular attention is given to questions of the preparation of samples for measurement, construction of measurement devices, possible errors in the mea-

surement, and methods for their elimination. As an example of the methods discussed, the apparatus and method of measurement of the activity of tritium-labeled compounds on chromatograms are described. Recommendations are given for additional increase in the sensitivity of tritium scintillation counters. (tr-auth)

51237 APPARATUS FOR CONTINUOUS MEASUREMENT OF THE CONCENTRATION OF RADIOACTIVE AEROSOLS. Starcuk, Zenon (Instrument of Plant Instrumentation, Brno); Vydra, Milos. Zdrav. Tech. Vzduchotech., 11: No. 2, 75-9(1968). (In Czech).

A functional sample of apparatus for continuous measurement of the concentration of radioactive aerosols is described. It includes an electrostatic separator for aerosol separation of the air which permits measuring the activity of the aerosol during its accumulation on the collector electrode. (auth) (JPRS)

51238 LITHIUM-DRIFTED SILICON P-I-N NUCLEAR PARTICLE DETECTORS. Miyashita, Kyoichi; Sugawa, Yoshiyuki (Mitsubishi Electric Corp., Japan). Mitsubishi Denki Lab. Rep., 8: 149-56(Apr. 1967).

Three types of lithium-drifted silicon p-i-n nuclear particle detectors were fabricated and tested. They are SD-16L series (active area 4×4 mm^2) SD-20L series (2×10 mm^2) and SD-36L series (6×6 mm^2) detectors. The best energy resolution obtained with internal conversion electrons of ^{137}Cs (625 keV) was 12 keV fwhm at room temperature. Detectors with the energy resolution of less than 20 keV fwhm were produced commercially without particular difficulties. (auth) (NSA of Japan)

51239 IONIZATION CURRENTS IN HEXANE INDUCED BY CORPUSCULAR RADIATION. Chybicki, M. (Danzig Technical Univ.). Acta Phys. Pol., 34: 285-9(Aug. 1968).

Experimental results treating the effect of the liquid's temperature and the interelectrode spacings in the ionization chamber on the value of the measured current induced by α or β particles are presented. (auth)

51240 MEASUREMENT BY LIQUID SCINTILLATION COUNTING. pp 100-48 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The design, operation, and counting efficiency of the liquid scintillation counter are discussed. The reproducibility of the results obtained with liquid scintillation counting is contingent upon the constancy of operation of the counter. Under optimal conditions, the counting efficiency for tritium β particles is commonly 15%. The energy transfer mechanisms for tritium β particles with the scintillation molecules in the solution are discussed also. The following topics are included in the discussion in relation to their role in tritium β-counting by liquid scintillation; quenching, phosphorescence, chemiluminescence, background-counting rates, simultaneous assays for tritium and ^{14}C, counting statistics, and applications to various chemical systems. (E.R.B)

51241 DANGER ALARM AND WARNING INSTALLATIONS OF THE JUELICH NUCLEAR RESEARCH PLANT. Wiedemann, K. Nachrichtentech. Fachber., 31: 29-33(1966). (In German).

From Conference on Telemetry and Remote Control, Kassel, West Germany.

A brief description of the Juelich Research Center is given. Schematics of the centralized safety system are shown. The remote area monitoring and alarm systems are described in detail. (M.L.S.)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 50934, 51099, and 51291.

51242 (CEA-R-3467) ROTOR CALCULATIONS FOR NEUTRON SPECTROSCOPY. Gobert, Guy (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1968. 53p. (In French). Dep.

The determination of stress in a rotating disk plane of symmetry normal to the axis of rotation has been studied by a number of investigators. In a recent paper Reich gives an operating process for an analytical solution in an asymmetric rotating disk. The calculation of finite difference stress solutions applicable to the two rotating disks is presented. The equations are then programmed for the 360-75 computer by Fortran methods concerning the rotors of choppers. (auth)

51243 (IA-1165) COMPUTER PROGRAM FOR THE LEAST SQUARES ANALYSIS OF GAMMA RAY SPECTRA INCLUDING A CORRECTION FOR SHORT-LIVED RADIONUCLIDES. Gavron, A. (Israel Atomic Energy Commission, Tel Aviv). June 1968. 24p. Dep.

A computer program for the least squares analysis of gamma ray spectra is described. The program includes automatic gain and threshold shifting, and a correction for short-lived radionuclide decay. (auth)

51244 (NP-tr-1693) STABILIZATION SYSTEM FOR A TIME-OF-FLIGHT SPECTROMETER OF NANOSECOND RANGE. Lapshin, V. G.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by J. E. Baker (Atomic Energy Research Establishment, Harwell, Eng.), from report JINR-P13-3342. 25p. Dep. CFSTI. UK.

This paper was previously abstracted from the original language and appears in NSA as 21: 34469. (W.H.K.)

51245 (RHEL/R-161) LOW BACKGROUND COUNTING ROOM AND ANCILLARY APPARATUS. Burrells, W. (Rutherford High Energy Lab., Chilton (England)). Mar. 1968. 15p. Dep. CFSTI. UK 4s.

A suitable thermal and radiation shield was sought for a room in which low background spectrometry could be carried out. A chalk block structure housing counting castles constructed from parts of pre-1939 naval guns was built, with all heat-generating apparatus sited outside the shield. (auth)

51246 (RT/EL-(68)1) RESEARCH ON THE CONDITIONS OF BEST RESOLUTION IN SEVERAL PHOTOMULTIPLIERS COMMONLY USED IN GAMMA SPECTROMETRY. Calza-Bini, A.; Clemente, G. F.; Moncassoli, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 23p. (In Italian). Dep.

A study was made to determine the best operating conditions for a photomultiplier tube in order to obtain high resolution. The photomultiplier was coupled to a NaI(Tl) scintillation crystal and the γ spectrum of a ^{137}Cs source of such activity as not to cause saturation was measured. The experimental device is described in detail. The resolutions obtained are shown graphically presented as a function of the variation of the focusing grid voltage. (J.S.R.)

51247 LARGE SODIUM IODIDE DETECTOR (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1771).

9 drawings.

A large sodium iodide double-crystal detector used to measure the decay curves of pure positron emitters formed in activation analysis with photons and charged particles is described. The NaI assembly can also be used in triple coincidence with a Ge(Li) detector to form an efficient pair spectrometer with good resolution. The large crystal assembly is also efficient in suppressing the Compton distribution in Ge(Li) detector spectra. More than 90% of the Compton events which result in a scattered photon entering the NaI are eliminated from the spectrum. (For details see TID-4100 Suppl. 48). (F.S.)

51248 POSSIBILITIES OF APPLICATION OF NEUTRON SPECTROMETRY IN NUCLEAR GEOPHYSICS. Vakhtin, B. S.; Filippov, E. M. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geol. Geofiz., No. 2, 101-8(Feb. 1968). (In Russian).

The construction of a neutron spectrometer is described. It is particularly designed for studies of high concentrations of B, and can be applied to the study of other elements with high neutron capture cross sections. Study of the cross-section vs energy plot for several elements led to the adoption of Cd, In, and Ag filters. The method used for quantitative determinations is based on a different technique, involving resonance determinations. Use of the filters, particularly Ag, removes the chief difficulty with this technique, insensitivity to concentration at relatively high concentrations. Thermal neutrons are linearly absorbed only up to 2% B without filters; with In filters, two linear regions with different slopes, 0 to 3% B and 5 to at least 15%, are usable for quantitative B analysis; Ag filters provide a linear scale from 0 to 15%. Experimental calibration curves are illustrated. Other applications in nuclear geophysics are suggested. (BBB)

High Energy Physics Instrumentation

51249 (BNL-12897) THE SUPERCONDUCTING MAGNET FOR THE BROOKHAVEN NATIONAL LABORATORY 7-FOOT BUBBLE CHAMBER. Brown, D. P.; Burgess, R. W.; Mulholland, G. T. (Brookhaven National Lab., Upton, N. Y.). July 1968. 36p. Dep. CFSTI.

An air core, fully stabilized superconducting magnet which has been constructed for the Brookhaven National Laboratory 7-foot bubble chamber is described. The magnet incorporates conductor face cooling and stainless steel reinforcement in an effort to maximize the performance-cost ratio. The design approach is integral with that of the bubble chamber. The conductor selection, the magnet design, construction considerations, cryogenic support facilities, and preliminary test results are described. (auth)

51250 DETECTION OF COSMIC GAMMA RAYS USING A SPARK CHAMBER COUNTER SYSTEM. Stewart, Joseph Vernon. New York, Univ. of Rochester, 1968. 142p.

Thesis.

A spark chamber counter system designed to detect cosmic gamma rays is described. The results of a Monte Carlo calculation used to determine the response of the detector to incident gamma rays is compared with the experimental results. It is found that if one assumes that the single particle events are due to gamma ray interactions in the detector then the gamma ray spectrum at low energies must be steeper than that reported in the literature. Upper limits to the flux of 1-GeV gamma rays from several sources are determined. (Disser. Abstr.)

Radiation Dosimeters

51251 (AD-672475) EVALUATION OF GAMMA DOSIMETRY IN A NUCLEAR REACTOR ENVIRONMENT. Gibson, Nancy N.; Stuetzer, Max (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). June 1968. 38p. (NDL-TR-108). CFSTI.

An experiment was conducted by the United States Army Nuclear Defense Laboratory (USANDL) at the Harry Diamond Laboratories' Diamond Ordnance Radiation Facility (DORF) to evaluate the performance of the following gamma dosimeters: Silver-activated metaphosphate glass rods and plates, cobalt-activated borosilicate glass plates, manganese-activated calcium fluoride thermoluminescent dosimetry, and lithium fluoride thermoluminescent dosimetry. The radiation source was a nuclear reactor which provided a mixed radiation environment similar to that of a nuclear weapon test with greater control of geometry than is possible in a field experiment. It was also possible to vary the gamma-to-neutron ratio by a factor of approximately 10. (auth) (USGRDR)

51252 (CEA-R-3502) CALORIMETRIC MEASUREMENT OF STRONG γ-EMITTING SOURCES. Brangier, Bernard; Herczeg, Christiane; Henry, Robert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1968. 18p. (In French). Dep.

A description of an adiabatic calorimeter for measuring the real activity of strong γ-emitting sources by absorbing the emitted energy in a mass of copper is presented. Because of the difficulty of evaluating the amount of self-absorption, a calorimeter for measuring the self-absorption was built, and a description of it is given. The results of these measurements are fairly satisfactory. The calibration and the actual measurements obtained are given with a few corrections made necessary by the design of the apparatus. The correlation of the various results is discussed. (auth)

51253 (RD/B/R-828) RECOMMENDATIONS CONCERNING THE USE OF THE PERSONAL NEUTRON ALBEDO DOSIMETER. Brown, J. B. C.; Gayton, F. M.; Hall, J. A.; Harvey, J. R.; Webb, G. A. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). June 1967. 29p. Dep.

A system of personnel neutron dosimetry is described which utilizes a detector to monitor the thermal neutron albedo at the body surface resulting from incident neutrons of all energies. The response of the dosimeter as a function of incident neutron energy has been investigated both theoretically and experimentally. A prototype dosimeter has been designed and its performance determined in nuclear power station environments. The dosimeter has a minimum detectable total neutron dose of 5 mrem, an improvement of greater than 100 to 1 compared with the fast neutron track films when used in civil nuclear power station environments. Recommendations are made for the adoption of the dosimeter by the C.E.G.B. (auth)

51254 DOSIMETER COMPARISON BETWEEN DIFFERENT ACCELERATOR STATIONS. Kretschko, J. pp 76-80 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

For the comparison of treatment results and radiobiological experiments between different institutes it is necessary to have dosimeters calibrated by a standard instrument of a central standard laboratory (CSL). Therefore a simple and non-expensive calibration procedure is proposed. Radiation-sensitive probes should be sent by mail from the CSL to different institutes. In these institutes the probes are irradiated under special conditions and are sent back to the CSL for evaluation. The well-known Fricke-solution in small polyaethylene capsules is suitable for this purpose. Preliminary experiments have shown that the calibration value is not affected by storage of the irradiated solution in polyaethylene capsules for 21 days. The storage of non-irradiated solution in these capsules for 7 days has no influence on the radiation effect of the solution. The arrangement for carrying out comparative measurements by this method is fully described. The accuracy in such experiments is better than 5%; this is sufficient for the use of dosimeters in hospitals. (auth)

51255 CALORIMETRIC DETERMINATION OF ABSORBED DOSE WITH ELECTRONS. Laughlin, John S. pp 65-71 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The construction and operation of a micro-calorimeter for determining the absorbed dose produced by electron beams in various materials are described. Use of the micro-calorimeter for calibrating ionization chambers and chemical dosimeters is discussed. (W.H.K.)

51256 LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETER. Holloway, Arthur F.; Campbell, E. M. pp 61-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of lithium fluoride thermoluminescent dosimeters for dosimetry of electrons up to 35 MeV is described. Calibration curves are pesented. Results of absorbed dose measurements in phantoms and depth dose measurements in water are compared for thermoluminescent dosimeters, ionization chambers, ferrous sulfate dosimeters, and photographic film. (W.H.K.)

51257 DETERMINATION OF THE FRICKE G-VALUE FOR 30-MeV ELECTRONS WITH THE USE OF CALORIMETRIC TECHNIQUE. Hettinger, Gunnar; Pettersson, C. pp 57-60 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

With a water calorimeter the Fricke dosimeter can be calibrated directly in rad per O.D. unit. The calibration factor includes both the G-value of the actual dosimeter solution and the calibration of the photometer used. The calorimeter is therefore a standard for Fricke dosimetry of betatron electron and photon radiation under the reasonable assumption that the energy dependence of the Fricke dosimeter is inconsiderable inside the thermos flask. (auth)

51258 PHOTOGRAPHICAL DOSIMETRY. Garsou, Julien L. pp 51-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of photographic films for high-energy electron dosimetry is discussed. Topics which are briefly discussed include effect of visible light emitted by the irradiated transparent medium, sensitivity dependence on electron energy, dependence of response on incidence angle, effect of density of irradiated material, agreement between isodose curves, and effect of the apparent or instantaneous dose rate. (W.H.K.)

51259 MEASUREMENT OF THE POLARIZATION CORRECTION USING THE FRICKE DOSIMETER. Bewley, David Kevin. pp 48-51 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The dosimetry of 8-MeV electron and x-ray beams has been compared using the Fricke dosimeter, photographic film, and an ionization chamber. Certain discrepancies were observed and the Fricke dosimeter is recommended as the best method. (auth)

51260 CALCULATION OF ENERGY DOSE FROM IONIZATION MEASUREMENTS BY SECONDARY ELECTRON EQUILIBRIUM. Harder, Dietrich. pp 40-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

It is shown that in the case of dosimetry of fast electrons by means of ionization chambers the equilibrium of secondary electrons can be reached with good approximation. Instead of the dose conversion factor r, the relative mass stopping power s of the primary electron which is energy and depth dependent must be calculated. The precision of this method is of the order of 2% for all depths. (auth)

51261 INTRODUCTION ON THE DOSIMETRY OF HIGH ENERGY ELECTRONS. Pohlit, Wolfgang. pp 36-40 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Calibration of dosimeters for high-energy electrons is discussed. Dosimeter types with the equations for determining the absorbed dose in the instrument from the quality measured are tabulated. The problem of calculating the absorbed dose in the

surrounding medium from the absorbed dose in the instrument is also described. (W.H.K.)

51262 LOW-ENERGY QUANTUM RADIATION GLASS DOSIMETER. Yokota, Ryosuke (Tokyo Shibaura Electric Co., Ltd.); Muto, Yuhei; Naoi, Jiro; Nishijima, Shinji. J. Nucl. Sci. Technol. (Tokyo), 5: 486-7(Sept. 1968).

Low-energy quantum radiation below 40 keV down to 15 or 20 keV must be measured during plutonium fuel operation. A double dosimeter using two FD-P8-1 glasses ($8 \times 8 \times 4.7$ mm) covered by 1 mm thick plastic and 0.06 mm thick Cu-filters, which permits energy-independent dose determination, and also effective energy determination independently of dose determination is described. This method is suitable for utilizing the type FGD-3B fluorimeter. (auth)

51263 NEW POSSIBILITIES FOR ROUTINE USE OF OXALIC ACID SOLUTIONS IN MULTIMEGARAD GAMMA RADIATION DOSIMETRY. Markovic, V.; Draganic, I. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Radiat. Res., 35: 587-95(1968).

A new possibility of using oxalic acid in H_2O and D_2O solutions as a chemical dosimeter is discussed. A simple logarithmic equation is used for the calculation of the absorbed dose in the range of 1.6 to 100 Mrads. A procedure for routine use of the dosimeter and calibration data for different radioactive cobalt units is presented. (auth)

51264 A NEW SCINTILLATION DEVICE FOR DOSE DETERMINATION IN THE RECTUM AND IN THE BLADDER IN GYNECOLOGICAL RADIUM INSERTIONS. PART I. Caha, Archimiro (Oncological Inst., Brno). Strahlentherapie, 135: 539-52(May 1968). (In German).

A special scintillation dosimeter was developed for gynecological radiation therapy. This instrument is described in detail. It is compared with other dosimetric methods suitable for this purpose. Various dosimetric devices are considered from the viewpoint of their applicability to gynecological therapy. Conditions of intracavity dosimetry are given. (J.S.R.)

51265 ENERGY AND DEPTH DEPENDENCY OF FILM DOSIMETRY IN ELECTRON BEAM THERAPY. Kitabatake, Takashi (Niigata Univ., Japan); Okumura, Yutaka. Acta Med. Biol. (Niigata), 15: 233-6(Mar. 1968).

Energy and depth dependency in film dosimetry in high-energy electron beam therapy was studied. A Toshiba medical betatron BMR-31 type (31-MeV maximum energy) and a Toshiba condenser type chamber was used. The film used was Sakura gravure Normal C type, in which the exposure of 100 to 300 esu/cm^3 gives a blackening of 2.0 to 3.0. The film, in black vinyl envelopes, was inserted in polystyrene phantoms. In the energy range from 10 to 30 MeV with the same exposure, no evident variation of film blackening was detected. The film characteristic curves, obtained at depth corresponding to 100%, 50%, and 20% dose distribution levels, nearly coincided, an indication of the absence of depth dependency. The error ranges of dose measurements were distributed between −1 to +1%. It was concluded that film dosimetry is reliable and valuable for practical use in high-energy electron beam therapy. (BBB)

51266 BETA-, GAMMA-, AND X-RADIATION SENSITIVITY OF A NUCLEAR TRACK FILM. Barber, Donald E. (Univ. of Minnesota, Minneapolis). Amer. Ind. Hyg. Ass. J., 29: 358-63 (July-Aug. 1968).

The interference of beta-, gamma-, and x-radiation with nuclear track counting in Kodak Personal Neutron Monitoring Film, Type A, was examined for several irradiations with Pu−Be neutrons in combination with various exposures from other radiations. Neutron irradiations were 197, 1183, and 3550 mrems. Exposures to other radiations ranged from 50 mR to 5000 mrads. The data showed that x-ray exposures as small as 16 mR can severely interfere with nuclear track counting in Kodak Personal Neutron Monitoring Film, Type A. Conditions under which routine nuclear track counting should not be accepted as a measure of fast neutron irradiation are indicated. It was concluded that monitoring for fast neutrons with Type A film in the presence of low-energy photons was impracticable. (auth)

51267 THERMOLUMINESCENCE DOSIMETRY 1st REPORT: FUNDAMENTAL RESEARCH. Tanaka, Yoshimasu; Kuroda, Yasumasa (Tenri Hospital, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 536-45(Aug. 1968). (In Japanese).

Radiation dosimeters utilizing the thermoluminescent properties of lithium fluoride phosphor (LiF phosphor), calcium fluoride (CaF_2: Mn) and lithium borate ($Li_2B_4O_7$: Mn) have been developed. Dose response curve, response to radiation of different energies fading of response, and directional dependence were examined and compared. In routine use accuracies of 3% standard deviation in LiF micro-rod, 2% in LiF teflon disc, 3% in CaF_2: Mn and 4% $Li_2B_4O_7$: Mn were attained. The dosimeters can be reused many times following simple reprocessing procedures. The linearity of the response curve varies with dosimeters, method of reprocessing and radiation quality. Calcium fluoride showed best linearity in the range of 50 to 1,000 R. A slight increase of response per Rad for doses above 50 Rads were found in lithium fluoride and lithium borate. The dosimeters showed energy independence and constancy above 0.2 MeV energy. In low energy range, lithium borate is less energy dependent than lithium fluoride and calcium fluoride and the highest response was found in calcium fluoride. Lithium fluoride showed directional independence in a range of ±5%. Fading of response was 7% in lithium fluoride, 1−2% in lithium borate and 10% in calcium fluoride 7 days after irradiation when the response of 2 days after irradiation was regarded as 1. Glow curves of 3 dosimeters under several conditions were examined. Pre-irradiation annealing was found to have a definite effect upon the thermoluminescent glow curve of LiF. (auth) (NSA of Japan)

51268 LUMINESCENT DOSIMETRY FOR PERSONNEL MONITORING. Wright, C. N. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Nucl. Safety, 9: 510-15(Nov.-Dec. 1968). (DP-MS-68-3).

Recent developments indicate that thermoluminescent and radiophotoluminescent dosimetric systems may be widely accepted and used for personnel monitoring in the next few years. These systems are as good as the film badge in any situation and superior to it in cases where small doses must be integrated over long periods, where high exposures might be unexpectedly encountered, and where the energy dependence of the film might lead to erroneous dose interpretation. A brief description of the principles behind the system is given, and their salient features are compared. (auth)

Radiometric Instruments

51269 RADIOACTIVE ISOTOPE-ACTIVATED LIGHT SOURCE FOR COLOR PHOTOMETRY. Ross, H. H. (to United States Atomic Energy Commission). U. S. Patent 3,404,270. Oct. 1, 1968.

A radioactivity-activated scintillator is described which is utilized as a light source for a color photometer for quantitative chemical analysis, whereby illumination is obtained without external power consumption. The output of such a photometer, utilizing the above light source, is digital in nature and the precision obtainable is substantially greater than heretofore possible. (AEC)

51270 CLINKER-LEVEL METER USING RADIOISOTOPES. Ito, Norio; Suga, Koji. Semento Gijutsu Nenpo, No. 21, 180-2 (Dec. 1967). (In Japanese).

A clinker-level meter, using a gamma source was developed, which is capable of simple and continuous measurement and recording. The clinker-level meter itself and the results of its use are described. The principle is: when the γ-rays are allowed to penetrate through a cooler of clinker, they do so where clinker does not exist but do not where it exists. The detector is positioned such that the value there will be intermediate between the two. Then, the detector moves according as the clinker level varies. The construction on the detection side is simple because oil pressure is used as the driving power; failure of the operation is reduced due to the absence of a heat source; and the accuracy in measurement is ±15 mm. (NSA of Japan)

51271 NONDESTRUCTIVE LABORATORY MEASUREMENT OF MARINE SEDIMENT DENSITY IN A CORE BARREL USING GAMMA RADIATION. Preiss, Kenneth (Negev Inst. for Arid Zone Research, Beer-Sheva, Israel). Deep-Sea Res. Oceanogr. Abstr., 15: 401-7(June 1968).

General methods to measure density with γ radiation by backscatter or by transmission are reviewed briefly. System calibration problems are discussed and a method that uses liquid solutions of different densities is described and evaluated. The characteristics of the apparatus used in this method, which requires a 10-mCi ^{137}Cs source and a detector, are described. The apparatus gives nondestructive readings of density on cores within plastic tubes. The liquid solutions were homogenous and of accurately known density. An equivalent density of each solution, which is the density of the solution normalized to the chemical composition of the sediment, was defined and calculated from the chemical composition of each calibration solution and the dry sediment, and a value of the water content of the sediment. These were obtained from tables relating density and concentration for the solutions used, and by chemical analysis of the sediments measured. An error in density of not more than 0.33% (at water contents of 100%

or more) required an accuracy of 10% in the water content. If an inaccurate value of water content was assumed, the density values obtained could be multiplied by the ratio of the value used to that which should have been used. Comparison with densities determined by weighing showed that 86% of the compared differences covered a range of ±0.01 g/cm³. In only 2 comparisons out of 49 the greatest difference was 0.03 g/cm³. (BBB)

51272 MEASUREMENT OF THE ASH CONTENT OF CARBONS BY RADIATION. BIBLIOGRAPHIC REVIEW. Schiber, J.; Grillot, R. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl., No. 71, 5-11(May-June 1968). (In French).

The principle and the design of apparatus for the measurement of the ash content of carbon by γ transmission, γ backscattering, β backscattering, and by neutron methods are reported. The efficiency of each type of method is analyzed and compared with the other methods. (53 references) (J.S.R.)

51273 DEVICE FOR CONTINUOUS CONTROL OF FRESH CONCRETE VOLUME DENSITY OF PREFABRICATED CONCRETE CONSTRUCTION ELEMENTS. Isotopenpraxis, 4: 245-8(July 1968). (In German).

The requirements to the measuring device are explained with regard to: measurement accuracy, local resolution, measuring geometry, and radiation protection. The accuracy is wanted to amount to ±2 per cent (range of measurements: q = 2.0 to 2.4 g/cm³), and the local resolution to 20 cm (maximum production velocity: v_{max} = 1.5 m/min). Construction and calibration of the measuring apparatus are described. It is possible to use the calibration curves acquired with hardened concrete blocks for density measurements of fresh concrete, if the effects of water content and reinforcement are taken into account by corrections. The experimental equipment was tested on a concrete extruding machine during the production of slack reinforced roadway slabs. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 51164, 52354, and 53070.

51274 (AD-661358) LASA EXPERIMENTAL SIGNAL PROCESSING SYSTEM. Quarterly Technical Report No. 1. (International Business Machines Corp., Gaithersburg, Md.). Feb. 1967. Contract F19628-67-C-0198. 65p. CFSTI.

The effort expended to provide the hardware and software necessary to support research and development directed toward the study of seismic signal processing and tasks planned for execution during the next quarter are discussed. In addition, detailed information related to system data flow and hardware configuration, array interface monitor and control, programming, microcoding, and Washington Laboratory is presented in the appendices. (USGRDR)

51275 (AD-662627) DIGITAL TECHNIQUE FOR RECORDING TIME-DEPENDENT SPECTRA BY TIME-TO-PULSE-HEIGHT CONVERSION. Final Scientific Report, Part A. Bonfiglioli, Guido; Brovetto, Piero; Cortese, Cesare (Istituto Elettrotecnico Nazionale, Turin (Italy)). Apr. 1967. 25p. (AFOSR-67-2784). CFSTI.

The construction of electronics for recording time-dependent spectra of electroluminescent crystals is described. The fundamentals of the digital method employed to measure the distribution of delay between the excitation and the emission are briefly outlined pointing out its interest for specific problems. The electronic circuitry is then described and some preliminary experiments are reported that demonstrate the performance of the whole setup. (USGRDR)

51276 (IDO-17269) INSTRUMENT DEVELOPMENT BRANCH ANNUAL REPORT, 1967. Morrison, R. G. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Aug. 1968. Contract AT(10-1)-205. 125p. Dep. CFSTI.

Transducer development, including eddy current techniques, ultrasonic techniques, acoustic emission, neutron and reactor fuel temperature measuring techniques, flow detection, and a capacitance sensing height gage for nonconductive liquids, is reported. Systems engineering development, including computer interfaces, control systems, and specialized components, is described. Instrumentation for the ex-reactor ATR in-pile tube vibration simulation apparatus, seismic switch calibration system, vibration instrumentation during the ATR startup, and Zircaloy-2, zirconium oxide emissivity are discussed. (W.H.K.)

51277 (LA-3848, pp 97-107) BIOPHYSICS SECTION. (Los Alamos Scientific Lab., N. Mex.).

Two research papers and three abstracts of publications and manuscripts are presented describing the activities in this section. The research activities of the biophysics section include: design and performance of an automatic Coulter counter that does not consume the culture; design and performance of a fluorescent cell photometer for the rapid counting of individual fluorescent dyed cells; volume distribution and separation of normal human leucocytes; reliability of cesium-137 burden measurements in man; and construction of a low-frequency NMR spectrometer. (E.R.B.)

51278 (RISO-M-722) LECTURE ON THE RELIABILITY OF REACTOR INSTRUMENTATION. Timmermann, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1968. 14p. (In Danish). Dep.

Some of the basic reliability considerations of reactor instrumentations are described for a reactor course. (auth)

51279 (RISO-M-729) BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1. OKTOBER TIL 31. DECEMBER 1967. (Quarterly Report of the Electronics Department for the Period October 1–December 31, 1967). (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1968. 46p. (In Danish and English). Dep.

A summary is given of some activities and equipment of the department, especially an electrostatic precipitator developed for fission product detection in a reactor in-core loop, hybrid computer programs, ^{60}Co intercalibration, and a digital delay generator giving timing pulses with 1 μsec to 300 msec time distances in 100 μsec steps. An outline of an on-line computer instrumentation for DR2 is given in English. This instrumentation is to be used for man-machine experiments using cathode-ray-tube light-pen communication. (Denmark)

51280 INTEGRATING WINDOW AMPLIFIER (Engineering Materials). (California Univ., Berkeley). (CAPE-1774).

5 drawings.

A window amplifier which senses pulse area rather than pulse amplitude is described. The amplifier is used to improve linearity, reduce resolution degradation resulting from rise-time jitter and simplify amplifier drive requirements. Differentiation and integration times are automatically equalized. Signal-to-noise performance appears to be equal to that of a conventional amplitude-sensing system. (For details see TID-4100 Suppl. 48; see also 21: 8642) (F.S.)

51281 APPARATUS FOR MEASURING TOTAL AND DIFFERENTIAL CROSS SECTIONS FOR ION-NEUTRAL INTERACTIONS (Engineering Materials). (California Univ., Berkeley). (CAPE-1766).

258 drawings.

A beam apparatus for studying the dynamics of ion-neutral interactions in the primary ion energy range 5 to 500 eV is described. High vacuum conditions are employed to study single biomolecular collision by employing a crossed beam method or by passing the ion beam through a scattering cell containing a target gas. (For details see TID-4100 Suppl. 48; see also 22: 395) (F.S.)

51282 MASS SPECTROMETER ION SOURCE FOR IONIZATION CROSS-SECTION MEASUREMENTS. Crawford, C. K. (Massachusetts Inst. of Tech., Cambridge). J. Vac. Sci. Technol., 5: 131-40(Sept.-Oct. 1968).

A new electrode geometry for a crossed-beam mass-spectrometer ion source has been developed. The geometry is particularly suited to the measurement of electron ionization cross sections for low vapor pressure materials and for materials which would normally contaminate source surfaces. Ions are generated at the intersection of an electron beam and an atomic beam in the center of a six-sided ionization chamber, each side of which is formed out of fine wire grids. By applying different electrical potentials to the grids and by passing trickle currents directly through the grid wires (resulting in small voltage drops), a variety of calculable field configurations may be set up. Passing higher currents through the grids allows the structure to be flashed clean. No insulators are exposed to any beam. The ions are extracted perpendicularly to both the electron and atomic beams; extraction in one direction shoots them into a large quadrupole mass spectrometer, extraction in the opposition direction shoots them into a total ion collector. The chamber may be run with a uniform electric extraction field, with conventional nonuniform fields, as a field-free region, in a saddle potential mode, or in a variety of pulsed modes. The source has been used in the uniform field mode to measure the absolute electron-ionization cross sections for several metals. (auth)

51283 400 CHANNEL PULSE HEIGHT ANALYZERS TYPE ND-1667. Kurahashi, Koichiro; Onishi, Ryoichi (Mitsubishi Electric Corp., Japan). Mitsubishi Denki Lab. Rep., 42: 1138-42(Aug. 1968). (In Japanese).

Multi-channel pulse height analyzers are used in application requiring a qualitative and quantitative analysis of nuclear radiation. Their application has been extended up to the fields of nuclear physics, bio-medical electronics, and quality control in general industries. A newly developed 400-channel pulse height analyzer is described. Provided with integrated circuits, it is small sized and maximum reliability is ensured. A plug-in unit system is used so that it can be used for various kinds of analysis. Arranged in sub blocks according to the classified functions, it is built suitable for mass production. (NSA of Japan)

51284 ELECTRONIC CALCULATOR WITH 4 AND 12 CHANNELS. Fratiloiu, Gh.; Teodoru, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 20: 555-60(1968). (In Hungarian).

This apparatus was constructed and used at the WWR-S reactor for measuring thermal neutron flux. The neutron flux was realized by the method of characteristic frequency to study the thermalization process of neutrons in various moderators (water, deuterium, graphite). The principal constituents of the device are: the apparatus for the triggering and stopping of measurements at the same point, the apparatus sorting the pulses by 4 or 12 channels, and the apparatus for the decoding from the base 2 to the base 12. (tr-auth)

51285 DIGITAL 8-CHANNEL ANALYZER FOR MULTI-PARAMETER SPECTROSCOPY. Patzelt, R.; Buschbeck, F.; Fuhrer, A. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf, Austria). Acta Phys. Austr., 26: 371-5 (1967). (In German).

In multi-parameter spectroscopy, especially in the assignment of energy spectra from two detectors in coincidence, the pulse height distribution from a detector is measured with dependence on the appearance of certain pulse height ranges in the other detector. The number of ranges is generally low, but their limits must be explicitly defined. An analog-to-digital converter was developed with supplementary logic circuits which makes it possible to define digitally eight ranges within 100 channels. The initial pulse can therefore be used to split up a spectrum in a multichannel analyzer a maximum of 8 times. In contrast with the usual methods with approximately equal channel widths in both ADC the fine standardization of the range limits permits an improved adaptation to the experiment, an improved utilization of the storage capacity available, and saves the addition of many partial spectra. (tr-auth)

51286 COMPARISON OF PHOTON COUNTING AND CURRENT MEASURING TECHNIQUES IN SPECTROPHOTOMETRY OF FAINT SOURCES. Tull, Robert G. (Univ. of Texas, Austin). Appl. Opt., 7: 2023-9(Oct. 1968).

The component of dark noise produced by Cherenkov pulses in photomultipliers due to cosmic ray μ mesons is discussed. It is shown by integration of pulse height spectra that this source of noise can be the limiting factor in dc measuring spectrophotometry of faint astronomical sources. Direct current methods of photometry are compared with photon counting, and the advantage of photon counting is demonstrated under various operating conditions. (auth)

51287 COMPUTERS, CHEMISTS, AND CRYSTALLOGRAPHY. Hamilton, Walter C. (Brookhaven National Lab., Upton, N. Y.). J. Comput. Phys., 2: 417-38(June 1968).

The computer-controlled system developed by the Instrumentation Division and the Applied Mathematics Department of Brookhaven National Lab. is described, and the hardware associated with the computer system is summarized. There are now 9 neutron experiments attached to the system. The use of the Brookhaven Multiple Spectrometer Control System, an on-line, time-sharing system for computer-controlled data acquisition, is described in detail, and some examples of direct methods of crystal structure determination are discussed briefly. The techniques of 3-dimensional illustration of crystal and molecular structures and computer analysis of thermal motions to present the wealth of material available in a crystal structure determination are considered, with examples. The importance of improved literature and data retrieval techniques is mentioned. (BBB)

51288 COLLIMATORS IN NEUTRON TIME-OF-FLIGHT POWDER DIFFRACTOMETRY. Holas, Andrzej (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 13: 753-63(1968).

The role of collimators in the time-of-flight neutron diffractometry is discussed. Special attention is paid to their contribution to the intensity and resolution. The cases of limited width of a collimator and absorbing sample are considered separately. (auth)

51289 THERMOCOUPLE PROTECTOR (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1773).

7 drawings.

An intrinsically safe circuit protector for thermocouple circuits is described which permits the use of thermocouples with an open, patch-panel type system in hazardous areas. Fuses are used to protect against faults which might last over 25 msec, metal-film resistors are used to limit current available in the hazardous area during fault conditions, and a bridge rectifier is used to bypass or short-circuit fault current to ground. (For details see TID-4100 Suppl. 48) (F.S.)

51290 DIGITAL TIME INTERVALOMETER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1768).

4 drawings

A digital time intervalometer for measuring time intervals of a msec or less with a time resolution of ~200 psec is described. The start signal can be delayed from 5 nsec to the full range of ~1 msec. The range of the instrument is independent of the selected delay and can be set to cover intervals from 100 nsec to ~1 msec. (For details see TID-4100 Suppl. 48) (F.S.)

51291 NEW TYPE OF X-RAY GENERATOR. Beekman, W. J. H. (Technical Univ., Eindhoven, Netherlands). Philips Res. Rep., Suppl. No. 7, 1-45(1968).

Thesis.

The principle of the described x-ray generator is a variation upon the direct-current inductor with the grid-controlled x-ray tube itself acting as the interrupter. The anode of the x-ray tube is connected to a constant-voltage generator via a high-inductance coil. The capacitance is constituted by the sum of the capacitances of the tube, the leads, and the coil. The main feature of the x-ray tube is the electron gun, consisting of a multi-grid construction of the Pierce type and a dispenser cathode with a concave emitting surface. The tube current is controlled by variation of the accelerating-grid voltage. By applying periodically a negative voltage pulse of rectangular wave form to the accelerating grid the capacitance is loaded at a low voltage and discharged at a high voltage alternately. The main data are: maximum voltage 250 kV, maximum tube current 300 mA, repetition frequency about 1100 Hz, discharge time about 50 μs. Also a spectrometer is described specially designed for measuring the high voltage and the spectral-energy distribution of the x-radiation produced. (auth)

51292 TELEMETRY AND REMOTE CONTROL VI, CONFERENCE, KASSEL, WEST GERMANY, JUNE 23–25, 1965. Nachrichtentech. Fachber., 31: 1-130(1966). (In German). (CONF-650680).

Separate abstracts were prepared for 2 of the 24 papers presented. The remaining 22 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 51241 and 53447.

Radiation Effects on Instruments and Instrument Components

51293 EFFECTS OF A HIGH-ENERGY PARTICLE ENVIRONMENT ON THE QUANTUM EFFICIENCY OF SPECTRALLY SELECTIVE PHOTOCATHODES FOR THE MIDDLE VACUUM ULTRAVIOLET. Heath, Donald F. (Goddard SFC, Greenbelt, Md.); McElaney, James H. Appl. Opt., 7: 2049-52(Oct. 1968).

The quantum efficiencies of spectrally selective photocathodes for the middle and vacuum uv (semitransparent depositions of CsI, CuI, and CsTe on Al_2O_3 windows, a solid tungsten photocathode behind a MgF_2 window) were measured before their use as detectors in a rocket experiment, one year later, and after irradiation by high energy electrons. Only the CsI photodiode showed any change in quantum efficiency, a notable increase after irradiation. Two additional CsI diodes were then irradiated, one with high energy electrons, the other with gamma rays. However, these diodes showed no change in quantum efficiency. The quantum efficiencies of all the photodiodes appear stable with time. The CuI and CsTe diodes also remain stable under irradiation, while the CsI diode may exhibit an increase in quantum efficiency after irradiation. (auth)

51294 EFFECTS OF γ-RADIOINDUCED RECOMBINATION CENTERS ON SILICON SOLAR CELLS. Usami, Akira (Nagoya Inst. of Tech., Japan). Oyo Butsuri, 37: 827-33(Sept. 1968). (In Japanese).

The spectral response, open circuit voltage, short circuit current, maximum power and the changes of matching load resistance in p-n and n-p type silicon solar cell, damaged at room tempera-

ture by γ-ray irradiation, were measured. These changes suggest the decrease of minority carrier life time by the introduced recombination centers under γ-irradiation. Minority carrier life time in bulk region were estimated by comparing maximum response wave length obtained experimentally with the calculated values. The normalized values of minority carrier diffusion length and the proportional factors of defect introduction rate, $\Delta(1/\tau) = 1/\tau_\gamma - 1/\tau_0$, were obtained from the changes of short circuit current. The changes of both the diffusion length and $\Delta(1/\tau)$ in p-n-type cell were larger than those in n-p-type, which were found to depend on the density of acceptor as dopant in p-type bulk region. (auth) (NSA of Japan)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 51363, 51384, 51482, 51555, 51563, 51643, 51647, 51662, 51797, 51798, 51800, 51828, 51838, 51854, 51862, 51867, 51874, 51875, 51911, 51914, 51937, 51944, 51999, 52003, 52004, 52036, 52038, 52049, 52060, 52091, 52093, 52094, 52096, 52097, 52102, 52111, 53490, and 53501.

51295 (AWRE-O-28/68) IN VIVO DISTRIBUTION OF PLUTONIUM IN RAT LIVER HOMOGENATES. Boocock, G.; Popplewell, D. S. (Atomic Weapons Research Establishment, Aldermaston (England)). May 1968. 28p. Dep. CFSTI. UK 4s. 0d.

The in vivo distribution of plutonium, injected intravenously in a primarily ionic form, was measured in the livers of rats. The measurements in cellular matter were made using differential centrifugation. Measurements in the soluble liver components were made using chromatographic methods. (INIS) (UK)

51296 (CERN/HER/AP-2-68) RADIONUCLIDES INDUCED IN BONE BY 600 MeV PROTONS. Pasinetti, Antonio; Hoffmann, Felix (European Organization for Nuclear Research, Geneva (Switzerland)). Apr. 1968. Contract 115-1945-0-1317. 64p. Dep.

Experimental data concerning radioisotopes induced in bone by 600 MeV protons are presented. Tables giving the dose, flux of irradiating particles, induced activation, disintegration rate, irradiation time, and energy of incident particles are given for the isotopes ^{7}Be, ^{11}C, ^{22}Na, and ^{24}Na. One series of tables includes data resulting from constant time of irradiation; another series includes data resulting from irradiation with constant flux of particles. The radioisotopes found in bone from γ counts after irradiation with high-energy protons were ^{7}Be, ^{11}C, ^{18}F, ^{28}Mg, ^{13}N, ^{22}Na, ^{24}Na, and ^{31}S; those found from β counts were ^{11}C, ^{18}F, ^{43}K, ^{28}Mg, ^{13}N, ^{24}Na, ^{32}P, ^{33}P, ^{35}S, and ^{31}Si. Tables are presented on the chemical composition of bone in standard man and on cross-sections for protons with kinetic energy of 600 MeV. (H.L.W.)

51297 (COO-119-238) RUBIDIUM AND POTASSIUM CONCENTRATIONS IN HUMAN ERYTHROCYTES, PLASMA, AND URINE. Wood, O. Lew (Utah Univ., Salt Lake City. Radiobiology Div.). Aug. 1968. 62p. Dep. CFSTI.

The naturally occurring rubidium and potassium concentrations were measured in human plasma, erythrocytes and urine for normal, diseased, and pregnant Utah subjects. The mean plasma Rb concentration in the normal adult subjects was 0.16 microgram/ml (μg/ml) with a standard deviation (SD) of $\pm$0.028 μg/ml and the mean K concentration was 160 μg/ml ($\pm$16.1 μg/ml SD). The mean erythrocyte Rb concentration in the normal adult subjects was 4.18 μg/ml ($\pm$0.623 μg/ml SD) and the mean K concentration was 3840 μg/ml ($\pm$142 μg/ml SD). The mean urine Rb concentration in the normal adult subjects was 1.52 μg/ml ($\pm$0.549 μg/ml SD) and the mean K concentration was 1910 μg/ml ($\pm$581 μg/ml SD). The Rb and K concentrations in the pregnant and diseased subjects did not vary significantly from the normal means. The mean estimated Rb dietary intake rate for the normal adult subjects was 2.16 mg/d ($\pm$0.747 mg/d SD) and the estimated mean rate for K was 2.46 g/d ($\pm$0.740 g/d SD). The Adjusted Retention Ratio (ARR), a ratio of concentration ratios, was defined as ARR = (Rb/K) Erythrocytes/(Rb/K) Excreta. The mean ARR for the normal adult subjects was 1.19 ($\pm$0.106 SD). A mean ARR > 1 indicated that Rb was preferentially retained in the erythrocyte compared to K when normalized for dietary intake. A subject with Duchenne muscular dystrophy had an ARR of 0.995 ($\pm$0.0695 SD). The estimated Rb whole-body burden in a normal 37 yr old, 82 kg, 178 cm tall male was 0.28 g as calculated from ^{83}Rb tracer measurements and the urine output rate of naturally occurring Rb. The Rb whole-body burden for a 15 yr old, 69 kg, 140 cm tall male with Duchenne muscular dystrophy was 0.064 g. (auth)

51298 (COO-1484-3) STUDIES OF ENDOCRINE METABOLISM AND FUNCTION IN DOMESTIC ANIMALS UTILIZING RADIOACTIVE ISOTOPES AS TRACERS. Final Progress Report, June 1, 1967-May 31, 1968. Romack, F. E. (Illinois Univ., Urbana). Contract AT(11-1)-1484. 14p. Dep. CFSTI.

Brief summaries of studies on thyroid gland metabolism using ^{131}I-labeled thyroid hormones are presented. The effects of these hormones on weight gain in swine; biological half lives of L-thyroxine and L-triodothyronine; effects of dietary nitrate on thyroidsecretion rate in lambs; effects of high levels of ^{131}I over a period of time (1 yr) on body tissues of swine; movement of in vivo labeled thyroid hormones to fetal tissues in rats and swine; and tissue localization of ^{131}I-labeled thyroid hormones by autoradiography are included Ablation of pituitary tissue by surgical placement of stainless steel seeds containing ^{222}Rn, ^{192}Ir, or ^{90}Y and liver function studies in normal equine subjects using ^{131}I are also included. Attempts made in the removal of single swine fetus from the intrauterine environment during gestation are discussed. (B.S.L.)

51299 (FOA-4-4319) STUDIES ON PLANT ABSORPTION OF ^{90}Sr AND ^{137}Cs FROM SOME TROPICAL AND SUBTROPICAL SOILS. Fredriksson, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). July 1963. 38p. Dep.

Plant absorption of ^{90}Sr and ^{137}Cs from six tropical and subtropical soils collected in South America was studied in pot experiments using winter rape as the test crop. The influence of additions of different anions and cations to the soils on plant uptake of the two fission products and of a number of plant nutrients was investigated. The results are discussed. (auth)

51300 (FOA-4-4321) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. IV. INFLUENCE OF EXCHANGEABLE AND NONEXCHANGEABLE POTASSIUM AND OF EXCHANGEABLE CALCIUM IN SOIL ON THE ABSORPTION OF ^{137}Cs BY RED CLOVER IN POT EXPERIMENTS WITH 178 SWEDISH SOILS. Fredriksson, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). July 1963. 24p. Dep.

The influence of lime and potassium status in soil on plant absorption of ^{137}Cs was studied in pot experiments with 178 representative Swedish soils. With the aid of multiple regression analysis functional relationships between the factors in question were found. It is suggested that the relationships found could be made use of for quantitative assessments of plant absorption of ^{137}Cs through root uptake. (auth)

51301 (FOA-4-4323) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. VI. A NEW EXPERIMENTAL TECHNIQUE FOR STUDIES OF PLANT ABSORPTION OF NUTRIENTS AND FISSION PRODUCTS UNDER FIELD CONDITIONS. Fredriksson, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Aug. 1963. 18p. Dep.

A new experimental technique for studies of plant absorption of nutrients and fission products from soils under field conditions has been designed. The technique is described and its merits in comparison with the conventional pot and field experiment techniques are discussed. (auth)

51302 (HUX-2643-42) INVESTIGATION ON THE MECHANISMS AND REGULATIONS OF NUCLEIC ACID AND PROTEIN SYNTHESIS, AND THEIR POSSIBLE RELATIONSHIP TO RADIATION DAMAGE. Progress Report, September 1, 1967-August 31, 1968. (Massachusetts General Hospital, Boston. John Collins Warren Labs.). May 29, 1968. Contract AT(30-1)-2643. 47p. Dep. CFSTI.

Studies of the biosynthesis of proteins were continued. The current emphasis is on the regulation of growth at the translational level, and the main focus is on the initial stages of protein synthesis where a highly specific transfer of information is involved when individual transfer RNA molecules are recognized by their own aminoacyl-tRNA synthetases. The tRNA or enzyme in specific sites was altered and the effects on the biological function were studied, thus pinpointing areas of the molecules involved in the recognition reaction. Earlier attempts to produce alterations in the tRNA by uv irradiation and in the enzyme by chemicals indicated a need for purified species of both in order to obtain meaningful interpretation of the changes produced. This year two synthetases from Escherichia coli were purified and characterized and several tRNA's were prepared in significantly enriched amounts. The production of unusual adenosine-5'-phosphates in rats by the lysyl-synthetase was further examined and nucleotide compounds with similar properties were scrutinized using ORD and CD in efforts to relate known structures to the tertiary structure of tRNA. Detection of nucleotides was greatly increased by examination of thin-layer plates in the uv range using low temperatures. In related studies of more complex systems, the nucleotide pools and RNA of regenerating rat liver and the protein metabolism of chick cells infected by an RNA-oncogenic virus were examined. (auth)

51303 (LA-3848) BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE HEALTH DIVISION. Annual Report, July 1966-June 1967. Ott, D. G. (comp.) (Los Alamos Scientific Lab., N. Mex.). Sept. 1967. 107p. Dep. CFSTI.

Separate abstracts are prepared on the five sections of this report. These include reports of research and abstracts of publications in molecular, cellular, and mammalian radiobiology, mammalian metabolism, and biophysics. (E.R.B.)

For abstracts of individual sections see: 51277, 51304, 51305, 51872, and 53498.

51304 (LA-3848, pp 21-61) MOLECULAR RADIOBIOLOGY SECTION. (Los Alamos Scientific Lab., N. Mex.).

Twenty-one abstracts of research, publications, and manuscripts are included in this section, describing the projects under investigation in the molecular radiobiology section. These projects include: purification, biochemistry, and synthetic activity of RNA polymerase; analysis of histones from Chinese hamster ovary, mammalian cells, bovine thymus, and chick embryos; enzymatic synthesis of oligo- and polynucleotides; gel electrophoresis of basic proteins, and their distributions in Chinese hamster ovary cells; and whole-body irradiation effects on urinary deoxycytidine in monkeys. (E.R.B.)

51305 (LA-3848, pp 75-96) MAMMALIAN METABOLISM SECTION. (Los Alamos Scientific Lab., N. Mex.).

Seven papers and eight abstracts of publications and manuscripts are included in this section, describing the research activity in the mammalian metabolism section. The projects discussed in this report include the metabolism, retention, turn-over rates, and methods for analysis of radioisotopes in beagles, man, mice, and rats. (E.R.B.)

51306 (ORAU-106) RESEARCH REPORT FOR THE YEAR ENDING DECEMBER 31, 1967. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.). 251p. Dep. CFSTI.

Separate abstracts are prepared on four of the five individual sections of this progress report. The section not included under separate abstract deals with medical divisions research in lipid metabolism. Of particular concern is the chemistry, analysis, biological distribution, and metabolism of o-alkyl and o-alk-1-enyl ethers of glycerol. The other four sections are concerned with; radiation studies, medical radioisotopes, metabolism and distribution of nuclides, and immunological studies. (E.R.B.)

For abstracts of individual sections see: 51307-51309 and 51874.

51307 (ORAU-106, pp 105-34) MEDICAL RADIOISOTOPES. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The objective of this aspect of the program is to apply radioisotopic test compounds in detection of tumors, measurement of functional disorders, and diagnosis of metabolic defects. The agents are radioactive compounds already available, or ones newly synthesized and tested in animals. This effort requires the skills of a number of staff members, particularly in organic chemistry, pharmacology, and instrumentation, and it requires animal studies on the application of radiopharmaceuticals in human diagnostic procedures. The final step of the sequence involves the clinical trials in the Medical Division's research hospital. Because of our major interest in both hematologic disorders and radiation damage to hematopoietic tissue, we have during recent years sought for methods of scanning the bone marrow by radioactive agents. Our clinical experience was enlarged during the past year, principally in the use of sulfur sol colloids of ^{99m}Tc, but this preparation remains less than ideal for marrow scanning. Advances in animal work with ferric oxide colloids indicate that such compounds deserve clinical trial, and we plan to undertake them when adequate testing has been completed. Progress in scanning depends on support in new instrument design and scanning technology. (auth)

51308 (ORAU-106, pp 171-93) THEORETICAL AND EXPERIMENTAL STUDIES IN METABOLISM AND DISTRIBUTION OF NUCLIDES. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Our objective is to quantitate patterns of absorption, distribution, and excretion of tracer metals, radionuclides of medical interest, and environmental and occupational contaminants. Where possible the work is done in patients with whole-body counting, combined with chemical and radioassay data. Selected questions arising out of the major objective have led to interesting results in animals. Also included in this section is a collaborative project involving neutron activation for analysis of gold thioglucose. The paper on phenothiazine inhibition of NADH oxidation by melanin represents work done by Dr. Melvin Van Woert while a temporary staff member. It is a preview of work in the area of phenothiazine toxicity, manganese toxicity, and Parkinson's disease that is being initiated by Dr. Edward Bird. He will also pursue related studies in endocrinology and metabolism. (auth) (TSS)

51309 (ORAU-106, pp 194-220) IMMUNOLOGIC STUDIES AND THE DEVELOPMENT OF THE MARMOSET AS A LABORATORY PRIMATE. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The program in immunology has evolved out of the objective of obtaining marrow transplants, particularly as a means of sustaining persons who were heavily irradiated. Because of the difficulties in achieving successful grafts in man as well as the obstacle of secondary or homologous disease (well demonstrated in experimental animals) the marmoset was chosen as an experimental tool. When natural chimerism was discovered in the species, interest in its immunologic and genetic usefulness broadened and a major effort was begun to develop an additional laboratory primate with certain unique features. Data collected in this project were grouped under a single heading along with immunologic studies devoted to effects of exposure rate and investigations of graft-host incompatibility. (auth)

51310 (SAN-509-2) FISSION PRODUCT UPTAKE BY CATTLE. Bohman, V. R.; Blincoe, Clifton; Lesperance, A. L.; Speth, C. F. (Nevada Univ., Reno). July 1968. Contract AT(04-3)-509. 5p. (CONF-680712-1). Dep. CFSTI.

From American Society of Animal Science Conference, Moscow, Idaho.

Radioactivity was released into the atmosphere from a low-yield underground explosion (Palanquin) on the Nevada Test Site April 14, 1965. The trajectory of the fission products was ascertained and animals were obtained for slaughter and tissue analyses from areas contaminated by these fission products and other locations within the state. Bovine thyroid I-131 was <1 pCi/g prior to the nuclear event. Thyroid ^{131}I obtained from animals at distances from the fallout pathway ranged from <1 pCi/g to 121 pCi/g immediately following the event, except on the Nevada Test Site where bovine thyroid ^{131}I averaged 600 pCi/g. The amount of thyroid ^{131}I on the fallout pathway decreased with distance from the Nevada Test Site as follows: 20 miles, 22,600 pCi/g, 5-21-65; 115 miles, 6,900 pCi/g, 4-28-65; and 220 miles, 1050 pCi/g, 4-30-65. The amount of ^{137}Ce in muscle and liver tissues and Sr and ^{90}Sr in bones of these animals did not seem to be related to the event. The content of some of these elements varied appreciably between locations. (auth)

51311 (UR-49-999) ^{137}Cs METABOLISM IN MAN. Murray, William Edward Jr. (Rochester Univ., N. Y.). 1968. Contract W-7401-49. 62p. Dep. CFSTI.

Thesis.

Cesium-137 absorption, biological half-time, and tissue distribution were measured. Whole-body counting and suitable parameters for change in calibration factors were considered. The long-term biological half-time was found to vary with geographical location, age, and sex. A metabolic difference is suggested as the reason for the first variable. Inconclusive experiments on the effects of growth hormone on ^{137}Cs retention by children were also conducted. (C.O.)

51312 CHANGES IN ^{65}Zn AND ^{59}Fe METABOLISM, AND CARBONIC ANHYDRASE AND CATALASE ACTIVITY IN ANIMALS WITH LIVER DAMAGED BY CARBON TETRACHLORIDE OR ETHIONINE. Suzuki, Shiro; Ogawa, Eiichi; Shibata, Katsuhiro; Tsuzuki, Hiroshi (Gunma Univ., Maebashi, Japan). Jap. J. Pharmacol., 17: 393-408 (Sept. 1967).

In mice given CCl_4 (0.01 ml) or ethionine (5 mg) once or twice, ^{59}Fe distribution in the spleen was increased by CCl_4 administration. In mice given CCl_4 (0.01 ml) or ethionine (2 mg) once daily for 8 days, ^{65}Zn and ^{59}Fe distribution remained unaltered. In the hepatic subcellular fractions, ^{65}Zn incorporation and carbonic anhydrase activity were both diminished in the supernatant fraction after CCl_4 administration twice per week, 8 to 11 times in all; ^{65}Zn and ^{59}Fe metabolism in the liver was unaffected. In mice given 2 mg of ethionine, twice per week and 8 to 11 times in all, ^{65}Zn and ^{59}Fe metabolism was unaltered. In rats given 0.8 ml/kg of CCl_4, twice/week and 36 times in all, ^{65}Zn and ^{59}Fe distributions in liver were unchanged. In hepatic subcellular fractions of rats with CCl_4-damaged liver, ^{65}Zn and ^{59}Fe incorporation remained unaltered. (BBB)

51313 A STUDY OF ^{45}Ca TURNOVER IN SKELETAL FLUOROSIS. Narasinga Rao, B. S.; Siddiqui, A. H.; Srikantia, S. G. (Nutrition Research Labs., Hyderabad, India). Metab., Clin. Exp., 17: 366-9 (Apr. 1968).

Calcium-45 metabolism was determined in 3 subjects with skeletal fluorosis who were on a constant intake of Ca (800 mg/day). They were administered 0.1 μCi/kg ^{45}Ca, and Ca and ^{45}Ca radioactivity in serum, urine, and feces were determined during the next 10 days. These patients showed a high-retention of dietary Ca and ^{45}Ca. An estimate of exchangeable pool of Ca and bone formation rate obtained from ^{45}Ca sp act. of serum and urine indicated that these parameters of Ca kinetics were much elevated in these subjects. (BBB)

51314 STUDIES ON SUBCUTANEOUS ABSORPTION IN MICE. V. ABSORPTION OF WATER INJECTED INTO THE SKIN OF NORMAL AND ESTRADIOL-TREATED ANIMALS. Secher-Hansen, E. (Univ. of Copenhagen). Acta Pharm. Toxicol., 26: 229-39(1968).

Cutaneous absorption of ^3H_2O was studied in male mice pretreated with 2 subcutaneous injections of estradiol monobenzoate, 10 μg in 100 μl peanut oil, 6 and 4 days earlier. Eighty μl of distilled water, 0.9% NaCl, or 10% sucrose containing about 0.3 μCi of ^3H_2O was injected subcutaneously in the right flank. In other mice, the same solution, but containing in addition 40 IU of hyaluronidase, was injected. In other experiments 80 μl of 0.9% NaCl containing 0.5 μCi of ^{131}I-human serum albumin was injected in a corresponding group with 40 IU of hyaluronidase. Five or 15 min after the injections the animals were killed and the difference between the total contents of radioactivity of skin pieces was determined. In estradiol-treated animals the weight of the injected skin increased during the first 15 min after the injection of ^3H_2O and addition of hyaluronidase accelerated the volume clearance significantly. This effect of hyaluronidase was not observed in the untreated animals. A similar effect of hyaluronidase in the estradiol-treated animals was seen after injection of 0.9% NaCl and 10% sucrose. Treatment with estradiol significantly inhibited the clearance of the injected ^3H_2O. When hyaluronidase was added, a faster clearance of ^3H_2O from pure water and 10% sucrose was seen, both in estradiol-treated and in untreated animals. After the injection of 0.9% NaCl, however, hyaluronidase had no effect on the rate of disappearance of ^3H_2O. In untreated animals the disappearance of ^3H_2O molecules was significantly faster in 0.9% NaCl than in water and 10% sucrose. After addition of hyaluronidase, however, the disappearance rates in these solutions were the same. (BBB)

51315 THE EFFECTS OF Ba^{2+} AND Mn^{2+} ON THE SMOOTH MUSCLE OF GUINEA PIG TENIA COLI. Buelbring, Edith; Tomita, T. (Oxford Univ.). J. Physiol. (London), 196: 137P-9P (May 1968).

Study of the spontaneous and evoked spike activity of tenia with the double sucrose-gap method showed that Ba and Ca increase the spike amplitude and duration. In Ca-free solution, when the membrane was depolarized and spikes and tension were very small or abolished, the addition of Ba (0.25 to 0.5 mM) caused gradual repolarization of the membrane and recovery of spikes and tension. With higher Ba concentrations (1.0 to 2.5 mM) the spike amplitude and duration increased further, forming a long-lasting plateau or a maintained state of depolarization. The plateau could be terminated by an inward current pulse or by adrenaline (10^{-7} g/ml.). After prolonged exposure to Ca-free solution containing Be (0.25 to 2.5 mM), adrenaline became ineffective. Addition of Ca antagonized the Ba effect and restored the action of adrenaline. Though Ba is effective in producing the spike it cannot replace Ca for the action of adrenaline for which Ca seems to be essential. (BBB)

51316 RELATIONSHIP BETWEEN THYROID FUNCTION AND GROWTH RATE. Draper, S. A.; Falconer, I. R.; Lamming, G. E. (Univ. of Nottingham, Eng.). J. Physiol. (London), 196: 91P-2P (May 1968).

To assess the relation between thyroid output and growth rate in normal animals, lambs were kept in a controlled environment in which thyroid ^{131}I release rate was shown to be highly correlated with secretion rate. Graphs illustrate the thyroid ^{131}I uptake and release, and an equation for calculation of the rate constant for ^{131}I release was derived. Measurements of ^{131}I release of lambs revealed a curvilinear relation between thyroid activity and growth that was highly significant. Thyroidectomy of lambs reduced their growth rate to 0.95 kg/week as compared with an average of 2.3 kg/week for sham-operated animals. There is an optimum thyroid activity for growth in lambs, and a reduced growth rate is associated with thyroid activities much above or below this value. (BBB)

51317 PERICARDIAL ABSORPTION OF THORIUM DIOXIDE IN RATS. I. AN ELECTRON MICROSCOPICAL STUDY. Kluge, Trond (Rikshopitalet, Oslo). Acta Pathol. Microbiol. Scand., 72: 64-86(1968).

Pericardial absorption of ThO_2 was studied at intervals of from 30 sec to 4 hr following injection of Thorotrast or of washed ThO_2 particles into the pericardial cavity of rats. Most absorption seemed to take place through the parietal pericardium; fewer particles were observed in the visceral mesothelium. Particles were present 15 to 20 min earlier in the parietal than in the visceral membrane, indicating movement of fluid across the pericardial space towards the parietal pericardium. The ThO_2 was absorbed through the mesothelial cells as free particles, in pinocytic vesicles and vacuoles, and in membrane-bounded dense bodies (lysosome-like structures). Only the vacuole-containing mesothelial cells absorbed Th particles. Particles were never observed in intercellular spaces. In the submesothelial tissue, Th was observed in free particles, and inside the cytoplasm of macrophages, mainly concentrated in lysosome-like dense bodies. It is suggested that acute cell from Thorotrast is caused by the suspension medium and not by the ThO_2 particles. (BBB)

51318 PERICARDIAL ABSORPTION OF THORIUM DIOXIDE IN RATS. 2. A LYMPHANGIOGRAPHIC STUDY. Kluge, Trond; Ongre, Aksel A. (Rikshopitalet, Oslo). Acta Pathol. Microbiol. Scand., 72: 87-102(1968).

Thorium deposition was visualized by x-ray examinations performed on living rats after injection of colloidal ThO_2 into the pericardial cavity. Radiographs were taken at time intervals from 30 min up to 16 days. Immediately following injection, the heart shadow had slightly increased density, owing to the spread of Th within the pericardial cavity. The first lymphatics were visualized 1½ to 2 hr following injection and opacification increased during the first 10 to 14 hr. From 16 to 24 hr, the density in the lymphatics appeared almost constant; at 34 and 48 hr, the opacification was decreasing; and after 16 days, the lymph vessels were no longer visible. The results suggested that pericardial lymph drainage takes place along 3 main pathways, i.e., the left parasternal, mediastinal, and diaphragmatic lymphatics. Anastomoses between these systems were detected. The x rays supported observations from electron microscopic studies indicating that a large proportion of injected ThO_2 is absorbed through the parietal pericardium. (BBB)

51319 MOBILIZATION OF CALCIUM IN FRACTURED BONES IN RATS. Singh, Lokendra M.; Della Rosa, Rocco J.; Dunphy, J. Englebert (Univ. of California, San Francisco). Surg. Gynecol. Obstet., 126: 243-8(Feb. 1968).

Strontium-85 was used to study Ca metabolism in Wistar rats subjected to fracture of the right humerus and left tibia 1 week after intraperitoneal injection of 10 μCi of ^{85}Sr. Total Ca and radioactivity in fractured and intact bones were compared. The Ca content and radioactivity increased simultaneously. In rats on a normal diet, the amount of increase in Ca was progressive, but the amount of increase in radioactivity remained constant. Since skeleton was the only source of the radioactive label, increased radioactivity in the fractured bone represents an index of the skeletal contribution. Whole-body retention and urinary excretion of ^{85}Sr and the $^{85}Sr-Ca$ ratio in blood were compared in groups of rats with fractured bone, those which had been traumatized, and those used as controls. Small, consistent, but not statistically significant differences were noted in the rats with fractures. There was a significant difference in the ash and Ca content of the normal bones in the rats with fractured bones. There was a detectable alteration of skeletal dynamics in the group with fractures, but it could not be demonstrated that this provided a specific contribution to the repair of the fracture. (BBB)

51320 EFFECTS OF GAMMA RADIATION ON THE ANAPHYLACTIC REACTION IN GUINEA PIGS. Protasova, O. V. (Gamalei Inst. of Epidemiology and Microbiology, Moscow). Zh. Mikrobiol., Epidemiol. Immunobiol., 41: 27-31(Oct. 1964). (In Russian).

Guinea pigs (weighing 200 to 250 g) were irradiated at 50-, 200-, 250-, 300-, and 350-R doses with a ^{60}Co γ-ray source. Irradiation was carried out prior to and after sensitization of guinea pigs with a standard horse serum that was administered subcutaneously in a 0.1-ml dose. The challenge injection of serum was given intravenously in a 1-ml dose, and the intensity of the anaphylactic reaction was evaluated. It was noted that the sensitivity of guinea pigs to irradiation was much higher in winter and spring, at which time radiation sickness was more lethal. Preliminary experiments established the effects of prior irradiation on the development of anaphylactic sensitivity to foreign protein. The results indicated that after a 200-R dose with sensitization after 24 hr, 3, 7, and 14 days following irradiation, and with a challenge injection after 7, 14, and 21 days following sensitization, anaphylactic shock was less severe than in control (nonirradiated) guinea pigs. After a 250-R dose was given to guinea pigs sensitized prior to and after irradiation, to induce fatal anaphylactic shock in animals irradiated 4 days prior to sensitization it was necessary to administer a larger dose of horse serum than to the control (nonirradiated) group and to guinea pigs irradiated after sensitization. Desensitization procedures proved to be as effective in the irradiated (300-R) guinea pigs as in nonirradiated ones. It was carried out 21 days after the sensitizing injection over a 3-day period; on both the 1st and 2nd day, 1-ml dose of standard horse serum was injected subcutaneously twice a day, then on the 3rd day 1 ml (diluted 1:5) intraperitoneally in the morning and 1 ml dose of whole

serum also intraperitoneally in the evening. The challenge injection was given on the fourth day. When irradiation (50 and 350 R) was carried out after sensitization, there was no change in the sensitivity of guinea pigs to repeated administration of foreign protein. (BBB)

51321 THE MOLECULAR NATURE OF THE NONLETHAL, NONHEREDITARY INJURIES TO BACTERIOPHAGES DUE TO ULTRAVIOLET IRRADIATION. **Zavil'gel'skii, G. B.; Kriviskii, A. S. (Inst. of Molecular Biology, Moscow). Microbiology (USSR) (Engl. Transl.), 34: 900-6 (Nov.-Dec. 1965).**

Ultraviolet irradiation (254 mμ) of virulent and temperate bacteriophages having double-stranded DNA (s_d, T2, T4, κ) induced a delay in development, manifested as a prolongation of the latent period (L). The linear relation between the effect and the uv dose indicated the cumulative nature of the nonlethal injuries in DNA. The increase in L in phage T4 after the same uv radiation dose was ~ half of that in phage T2, indicating effective repair of nonlethal injuries to DNA by the v-gene system. The nonlethal, nonhereditary uv injuries to DNA responsible for the delay in phage development are of the same physico-chemical nature as lethal injuries. The uv irradiation of bacteriophages having single-stranded nucleic acids (φX174, MS-2) did not lead to a delay in development. Two hypotheses are put forward to account for the nonlethal injuries to DNA: a repair hypothesis and a hypothesis that DNA has noncritical regions. (BBB)

51322 ABSORPTION OF ^{212}Pb FROM THE GASTROINTESTINAL TRACT OF MAN. **Hursh, John B.; Suomela, Jorma (Univ. of Rochester, N. Y. Statens Stralskyddsinstitut, Stockholm). Acta Radiol., Ther., Phys., Biol., 7: 108-20 (Apr. 1968).**

The gastrointestinal absorption on administration of ^{212}Pb by mouth to three human subjects was found to be respectively 1.3, 8.1, and 16.0%. The absorption was determined by a comparison of the 24-hour urinary excretion of these subjects with the average excretion in the same period by two subjects who received ^{212}Pb intravenously. The only obvious factor related to the wide range of absorption was that of age, increasing age being associated with decreasing absorption. The average value of 8% is equal to that used by ICRP. It is pointed out that this choice may not be conservative for an appreciable fraction of the population. The ^{212}Pb concentrations in the blood cells as a function of time after oral or intravenous administration suggest that lead may be released from the binding sites only when the red cell dies. The relationship of this proposal to permissible intakes of stable lead is considered. (auth)

51323 BIOPHYSICAL ASPECTS OF BIOLOGICAL EXPERIMENTS. Rajewsky, Boris. pp 134-40 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

A broad outline of the biophysical approach to radiobiological experiments and measurements is presented. (B.G.D.)

51324 UPTAKE OF CARRIER-FREE ^{137}Cs BY RAMALINA RETICULATA. Handley, Raymond; Overstreet, Roy (Univ. of California, Berkeley). Plant Physiol., 43: 1401-5 (Sept. 1968).

The uptake of carrier-free ^{137}Cs by Ramalina reticulata Kremp, does not appear to be directly linked to metabolism. The results indicate the presence of a barrier to entry of ^{137}Cs. The barrier is stabilized by Ca ions. Removal of Ca by pretreatment of the tissue in monovalent salt solutions increases the uptake of ^{137}Cs. Uptake under anaerobiosis is also greater than normal, but in this case, Ca displaced from the barrier membrane is not lost from the tissue and normal permeability is rapidly reestablished when aerobic conditions are restored. Under anaerobiosis Ca^{2+} increases damage to the respiratory mechanism presumably by increasing retention of toxic products. (auth)

51325 SELENIUM IN BIOMEDICINE. FIRST INTERNATIONAL SYMPOSIUM, OREGON STATE UNIVERSITY, CORVALLIS, 1966. Muth, O. H.; Oldfield, J. E.; Weswig, P. H. (eds.). Westport, Conn., AVI Publishing Co., Inc., 1967. 453p. (CONF-660957). DTIE.

This symposium contains 25 papers discussing the biomedical aspects of selenium. The following general areas are discussed in the papers: the distribution of selenium in soils and plant and animal tissues, and the analytical methods employed in its determination; the toxicity of selenium in farm animals, laboratory animals, and man, and the clinical investigation of the histopathological and physiological effects of this toxicity; the clinical aspects and physiological responses of man and farm animals to selenium deficiencies; the cycling of low and excessive levels of selenium in soils, animals, and plants; the absorption and metabolism of selenium in animals; microbiol research with selenium; selenium and vitamin E interrelations; the protective effects of selenium and zinc against cadmium-induced injuries in rat intestines; and the position of the food and drug administration regarding the legal status of selenium in products destined for human use or consumption. A summary of the symposium and subject index are presented. (E.R.B.)

51326 A METHOD FOR MEASURING THE GASTROINTESTINAL ABSORPTION OF ^{47}Ca USING ^{47}Sc AS AN INERT MARKER. **Ogg, C. S.; Pearson, J. D.; Veall, N. (St. Philip's Hospital, London). Clin. Sci., 34: 327-32 (Apr. 1968).**

A new radioisotope method was developed for the measurement of the intestinal absorptive of ^{47}Ca in man. The daughter isotope ^{47}Sc was employed as an inert marker and protected against errors arising from the loss of feces. It was shown that an additional inert marker such as ^{51}Cr was not necessary during the study of the intestinal absorption of ^{47}Ca since it was possible to take advantage of the fact that ^{47}Ca decays to a daughter isotope, ^{47}Sc, which is not absorbed by the gastrointestinal tract. A procedure for the separation of ^{47}Sc from ^{47}Ca is described in which Sc is removed by ferric hydroxide. Results obtained with the new technique compared with those obtained using a standard technique based on the fecal recovery of an oral dose of ^{47}Ca were in good agreement. Complete fecal collections were unnecessary in the new method and the measurements could therefore be made easily and repeatedly on patients who were not confined to a hospital. (TSS) (BBB)

51327 ACCUMULATION OF ZINC IN MOUSE BRAIN: AN AUTORADIOGRAPHIC STUDY WITH ^{65}Zn. **Hassler, Ove; Soeremark, Rune (Univ. of Umea, Sweden). Arch. Neurol., 19: 117-20 (July 1968).**

A single dose of 250 μCi ^{65}Zn in 0.5 ml of solution was injected intraperitoneally in adult male mice. This indicates that the resorption of Zn from the cerebrospinal fluid (CSF) through the pacchionian granulations may be slow. They were killed 1 to 6 days afterwards, and their brains were removed and sectioned for autoradiographic examination. A heavy accumulation of ^{65}Zn was seen in the mossy fiber layer of the H_3 to H_5 portions of the hippocampus at all times after the injection. The gray substance (especially lamina granularis primaria) always contained slightly more radiozinc that the white matter. The granule cell layer of the cerebellum and the CSF exhibited a higher concentration of ^{65}Zn than the gray substance in other parts of the brain. (BBB)

51328 INVESTIGATIONS ON THE MECHANISM OF FORMATION OF VITAMIN D IN THE SKIN OF RATS. **Doboszynska, B.; Dacenko, Z. M. (Academy of Medicine, Danzig). Bull. Acad. Pol. Sci., Ser. Sci. Biol., 14: 199-204 (1966).**

The mode of action of uv radiation in the synthesis of vitamin D was studied by attempts to identify the substances formed in the skin of rats irradiated by uv in vivo and in vitro. The method used for determining vitamin D consisted in saponifying the skin, extracting the nonsaponified fraction, purification from the bulk of sterols by column chromatography on Al_2O_3, separation of substances closely related to vitamin D by thin-layer chromatography, and their identification by spectrophotometry in the uv range. In nonirradiated rats, the presence of 4 substances with an absorption maximum at 250 mμ was established. In rats irradiated once, 3 substances with this maximum were found, and amounts of one of the substances surpassed by 50 times that found in the skin of nonirradiated rats. In the skin of repeatedly irradiated rats, only one substance with an absorption maximum at 250 mμ was found. Two substances also were found showing strong absorption at 240 to 300 mμ without any characteristic maximum as well as substances with an absorption maximum 270 to 281 mμ (characteristic for tachysterols), which were not detected in the skin of the other rats (irradiated once or nonirradiated). In all instances, substantial amounts of 7-dehydrocholesterol were detected. In rats irradiated once it was 10 times higher, and in rats repeatedly irradiated 20 times higher than in nonirradiated animals. No vitamin D was detected in any experiments. It was concluded that the uv irradiation of rats may cause the appearance in the skin of substances other than vitamin D, substances with antirachitic activity or which are transformed into vitamin D. (BBB)

51329 TRACE METAL ACCUMULATION BY ESTUARINE MOLLUSKS. **Pringle, Benjamin H.; Hissong, Dale E.; Katz, Edward L.; Mulawka, Stefan T. (Northeast Marine Health Sciences Lab., Narragansett, R. I.). J. Sanit. Eng. Div., Amer. Soc. Civil Eng., 94: 455-75 (June 1968).**

Extensive data are compiled for the uptake by marine organisms, especially mollusks, of Sr, Ba, Co, U, La, Sc, Y, and many other trace metals. The modes of toxic action of these metals are considered. Trace metal enrichment factors for shellfish compared with that of the marine environment are tabulated. (TSS) (BBB)

51330 UPTAKE AND RETENTION OF PARENTERALLY ADMINISTERED ^{75}Se IN EWES ON DIFFERENT SELENIUM REGIMENS. **Muth, O. H.; Pendell, H. W.; Watson, C. R.; Oldfield,**

J. E.; Weswig, P. H. (Oregon State Univ., Corvallis). Amer. J. Vet. Res., 28: 1397-1406 (Sept. 1967).

Ewes fed a Se-adequate or a Se-deficient ration were injected subcutaneously with 150 μCi of ^{75}Se (5 mg) as sodium selenite in saline solution or peanut oil-wax base. Whole-body and blood radioactivity was measured up to 119 days postinjection when the ewes were killed and radioactivity of various organs was determined. Those fed a ration deficient in Se content had a greater uptake and retention than similar ewes fed a ration adequate in Se. At termination, the ewes on the Se-deficient ration retained about 25% of the maximal activity found at 4 hr postinjection, whereas the ewes on the Se adequate ration retained about 10%. Retention of ^{75}Se was expressed in two components: the first consisting of a relatively short period of rapid elimination and the second consisting of a relatively long period of slow elimination. The first component had a biological half-life of less than 1 day and accounted for unfixed ^{75}Se that was excreted during the period. In the second component, the Se-deficient ewes had greater retention of ^{75}Se than ewes on adequate Se intake. The peanut oil also enhanced retention of ^{75}Se in Se-deficient ewes. (BBB)

51331 EFFECTS OF LASER IRRADIATION ON SOME SEROLOGIC PROPERTIES OF HUMAN GAMMA GLOBULIN. Cohen, Elias; Klein, Edmund; Fine, Samuel (Roswell Park Memorial Inst., Buffalo). Life Sci., 7: 569-81 (June 15, 1968).

High and low intensities of ruby and neodymium laser irradiation (6943 Å and 10,600 Å respectively) of 1% saline solutions of human (HGG) and rabbit (RGG) γ-globulin produced an effect different from that of a thermal nature per se upon the precipitin reactions with rheumatoid factor. Heat treatment of globulin solutions at 63°C for 15 min caused aggregation and more precipitation with rheumatoid factor than untreated globulins, whereas laser irradiation reduced or destroyed the capacity for the globulins to precipitate rheumatoid factor. Precipitin reactions between rabbit anti-HGG and irradiated HGG demonstrated a shift of position of precipitin curve peaks, as well as reduction of total amount of precipitation. Ultracentrifugal analyses did not reveal additional components with laser irradiation of HGG, as were observed with heat treatment of globulins. Immunochemical agar gel diffusion and immunoelectrophoretic analyses revealed slight differences between laser-irradiated and native globulins. It was concluded that the interactions of high intensity electromagnetic (laser) radiation with globulins differ from those of heat per se, as demonstrated by differences in the serologic activity, certain physicochemical changes, and other pertinent parameters of the respective reactions. (BBB)

51332 IODINE UPTAKE BY OVA OF HENS GIVEN EXCESS IODINE AND EFFECT UPON OVA DEVELOPMENT. Marcilese, N. A.; Harms, R. H.; Valsecchi, R. M.; Arrington, L. R. (Univ. of Florida, Gainesville). J. Nutr., 94: 117-20 (Feb. 1968).

A study was made of the uptake of ^{131}I by ova at different stages of maturation, the patterns of excretion into eggs and radioiodine content of eggs, the whole body, and selected tissues of hens given high levels of iodine. White Leghorn hens were dosed orally for 14 days with a solution of $Na^{131}I$ and the ^{131}I distribution was determined. Daily dose levels were 100 mg in a single dose, 500 mg in 2 administrations, or 500 mg in a single dose. Iodine-131 in the eggs of hens given 100 mg iodine daily increased linearly for 10 days and reached a plateau of 3 mg/egg at that time. Concentration in the eggs from those given 500 mg increased rapidly to an average content of 7 mg/egg by 8 days at which time most hens ceased production. Ova continued to develop in hens not laying and many ova were found to be regressing. It was suggested that when a threshold amount of iodine reached the ova, development ceased and regression took place. (BBB)

51333 RADIOCALCIUM STUDIES IN NORMAL SUBJECTS. Tomlinson, R. W. S.; Wall, M.; Osborn, S. B.; Anderson, J. (London Univ.). Calcified Tissue Res., 1: 197-203 (Dec. 20, 1967).

Using Ca balance techniques and ^{47}Ca, 12 normal subjects were studied to provide normal reference values for metabolic ^{47}Ca studies in adult humans. A composite graph of plasma and urinary ^{47}Ca specific activity was presented at intervals from 0.1 to 300 hr after ^{47}Ca injection. It was suggested that an adequate representation of this data may be made by means of two power functions. The practicality of this interpretation is discussed. (BBB)

51334 UPTAKE AND DISTRIBUTION OF ^{65}Zn IN THE COHO SALMON EGG (ONCORHYNCHUS KISUTCH). Wedemeyer, Gary (Bureau of Sport Fisheries and Wildlife, Seattle). Comp. Biochem. Physiol., 26: 271-9 (July 1968).

Salmon eggs were incubated at 12°C with 1 μCi/ml $^{65}ZnCl_2$ of specific activity 0.5 mCi/mg Zn. The incubation medium was adjusted to pH 6.5. Eggs were removed after the desired time intervals and rinsed with distilled water. After removal of samples of the perivitelline fluid, the chorion, yolk, and embryo were separated by dissection, and ^{65}Zn in the samples was determined using a well-type γ scintillation counter. Results showed that ^{65}Zn uptake was affected by pH, temperature, Cu^{2+}, 2,4-fluorodinitrobenzene and the azo dye, malachite green; but not by azide ion or 2,4-dinitrophenol. About 70% of the total accumulated ^{65}Zn was bound, rather firmly, to the chorion; about 26% was found in the perivitelline fluid, about 2% in the yolk, and about 1% in the embryo. Temperature, pH, inhibitor, and kinetic studies indicated that ^{65}Zn uptake involves physicochemical sorption to the chorion together with passive diffusion into the yolk and embryo. (BBB)

51335 AFTER EFFECTS OF THE REACTIONS OF VARIOUS RADIATIONS WITH RABBIT EAR CARTILAGE. Kaercher, K. H. pp 214-15 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Experimental histochemical examinations on the rabbit ear cartilage with different rays such as 200 kV x rays, ^{60}Co γ rays, and 6 MeV electrons showed increasing content of acid mucopolysaccharides after a total dose of 4000 R especially when using electron beam. With 200 kV x rays there was a decreasing tendency of acid mucopolysaccharides and signs of beginning necrosis. With ^{60}Co γ rays there were no definite signs of histochemical changes. (auth)

51336 CLINICAL EXPERIMENTAL EXAMINATION DURING ELECTRON THERAPY OF MALIGNANT MELANOMAS. Kaercher, K. H. pp 272-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The cell culture of irradiated melanoma showed growth after a total dose of 10,000 R fast electrons in different cases. Also the ferment examinations of malate dehydrogenase and of lactic dehydrogenase observed before and under treatment confirmed the differences of radiosensitivity of melanotic tumors. These ferment diagrams were in accordance with the histological picture of the excised tumors after electron therapy. (auth)

51337 USE OF LARGE ISOTOPIC SOURCES OF IRRADIATION IN CZECHOSLOVAK SOCIALIST REPUBLIC. Fridrich, Bedrich (Czechoslovak Atomic Energy Commission, Prague). Jad. Energ., 14: 270-3 (July 1968). (In Czech).

The uses of large isotopic sources of irradiation in Czechoslovakia are reviewed. Improvements in the use of these sources for research projects are discussed. The importance of the latest information from foreign countries is pointed out. (H.L.W.)

51338 EFFECTS OF ULTRAVIOLET LIGHT ON SKIN CHOLESTEROL. Rauschkolb, Elizabeth W.; Farrell, Gordon; Knox, John M. (Baylor Univ., Houston, Tex.). J. Invest. Dermatol., 49: 632-6 (Dec. 1967).

Sunlight or uv light induced a prompt and statistically significant reduction in the amount of freely extractable cholesterol in human skin in vitro. When isolated skin specimens mounted in the environmental chamber were exposed to the noonday sun, reduction in the sterol extractable from the skin occurred in the absence of any other physiological mechanism. The quantitative alterations in cholesterol content of Caucasian skin following exposure to uv light in vitro are also presented. The freely extractable cholesterol content in 6 untreated specimens of Caucasian skin was on the average 69.08 μg/g. The average decline amounted to 47.5% of the resting level and occurred within 2 min of the time exposure to light began. By contrast, in experiments with skin obtained from Negro subjects, the in vitro effect of uv irradiation was much less uniform. The mechanisms for these changes that remain unresolved at this time are discussed. (TSS) (BBB)

51339 THE Ca CONTENT AND ^{45}Ca EXCHANGE IN LONGITUDINAL MUSCLE STRIPS OF GUINEA PIG SMALL INTESTINE. Luellmann, Heinz; Siegfriedt, Annemarie (Univ., Kiel). Arch. Gesam. Physiol., 300: 108-19 (Apr. 8, 1968). (In German).

The Ca content and the ^{45}Ca uptake and loss in vitro were estimated in guinea pig small intestine. Ca by a spectrofluorophotometric method and ^{45}Ca by liquid scintillation counting. The Ca content as well as the ^{45}Ca fluxes of the smooth muscle were dependent upon the extracellular Ca concentration (0.6, 1.8, or 2.7 μmole Ca/ml). The tissue Ca concentration was well above the actual extracellular Ca concentration. The uptake and the loss of ^{45}Ca occurred faster the higher the Ca concentration of the medium. Tissue Ca was completely exchangeable. Only in Mg-free solution did the additionally accumulated Ca not exchange with ^{45}Ca. The cellular ^{45}Ca uptake occurred with one time constant only, whereas the ^{45}Ca loss from the muscle cells

displayed two different time constants. Complete depolarization of 140 μmole K/ml in the incubation medium did not change cellular Ca metabolism, but 40 μmole K/ml led to a sustained increase of tension and decreased the exchange rate in both directions. It is concluded that possibly only a small fraction of the cellular Ca is significantly involved in the coupling mechanism. (BBB)

51340 METABOLISM OF ^{90}Sr IN THE CHICKEN WITH PROLONGED INGESTION OF FEED. Panchenko, I. Ya.; Sarapultsev, I. A.; Pedchenko, V. I.; Povalyaev, A. P. Veterinariya, 43: 63-4(Apr. 1966). (In Russian).

Comparative data are presented on the accumulation of ^{90}Sr in cockerels and laying hens, on the rate of isotope loss from cockerels, and on the transfer of ^{90}Sr to the egg under chronic ingestion with the feed. Fifty 6-month-old cockerels and 40 20-month-old laying hens were used. The ration consisted of grains, potatoes, and vegetables with added tricalcium phosphate to maintain a level of Ca for the cockerels at 1 g and for the hens at 1.6 g. The birds were injected with 2.4×10^{-7} Ci ^{90}Sr every morning after feeding. The cockerels were killed in groups of 5 after 5, 10, 15, 20, 30, and 35 days after beginning of injections and the hens after 5, 15, 30, and 35 days. Bone, muscle, egg shell, yolk, and albumen were assayed for ^{90}Sr. The accumulation of ^{90}Sr in the skeleton of cockerels and laying hens in the 35-day investigation increased linearly and could be expressed by the equation $K = at$; where K is the multiplicity factor of the accumulation of ^{90}Sr in the skeleton in time (days) and a is the proportionality coefficient (the multiplicity factor of ^{90}Sr accumulation in the skeleton of a chicken in one 24-hr period). The variation of K with time in cockerels was expressed by $K = 0.2t$ and in laying hens $K = 0.14t$. Analysis of 187 eggs established that 40 to 60% of ^{90}Sr injected daily was transferred to a single egg, more being transferred the fewer the eggs produced. Most of the ^{90}Sr was located in the shell (97%) and only ~3% in the yolk (90%) and albumen (10%). Retention of ^{90}Sr in the skeleton of cockerels was examined by the least squares method and by exponential functions: $A_t = A_0 \cdot (0.693/1 - T_{e\Phi})$ where A_t is the ^{90}Sr retention in the skeleton (in curies) as a function of time (t, days); A_0 is the ^{90}Sr retention in the skeleton (in curies) after the cessation of priming doses; and $T_{e\Phi}$ is the effective half time of removal of the radiostrontium (in days). The regression equation $A_t = A_0 \cdot (0.693/1 - 14.5)$ expressed experimental data with a correlation coefficient = 0.66. Loss of ^{90}Sr from muscle took place at a faster rate than from the skeleton. The rate of isotope loss from muscle and the decreased transfer of the isotope to the yolk and albumen after cessation of injection of laying hens took place identically. Evidently, entrance of the ^{90}Sr into muscle, yolk, and albumen originated from the same source, the blood serum. (BBB)

51341 METABOLISM OF RADIOACTIVE CALCIUM BY CARTILAGE. Matthews, J. L.; Martin, J. M.; Collins, E. J. (Baylor Univ. Coll. of Dentistry, Dallas). Clin. Orthopaed. Related Res., No. 58, 213-23(May-June 1968).

Autoradiographic studies using very thin sections and electron microscopy were performed in 21-day-old albino rats injected with 5 μCi of ^{45}Ca and killed 6 min to 20 hr later. The tissues were processed in a series of solvents so that ionic ^{45}Ca would be leached out of the specimens and that only the Ca which was bound to a nondiffusible component would remain. Electron autoradiographic examination of growth plates showed a concentration of grains over the cells in the growth plate with an increase in grains over those cells in the immediate vicinity of the mineralization site. Later, grains were found in increasing amounts over the matrix in the mineralizing zones. Although more activity was noted in the cells of the hypertrophic and lower zones, it was not established whether the differential in activity was due to an increased amount of Ca-binding material within these cells or whether they had a metabolic pump which concentrated Ca against a diffusion gradient. Possibly, both conditions prevailed. The possible role of the cell as a modulator of calcification and an initiator of nucleation is proposed. (BBB)

51342 A STUDY OF THE DEPOSITION, TRANSLOCATION AND EXCRETION OF RADIOIODINE INHALED AS IODINE VAPOUR. Morgan, A.; Morgan, D. J.; Black, A. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys., 15: 313-22(Oct. 1968).

A number of experiments are described in which iodine vapor labelled with ^{132}I was administered to volunteer subjects to provide information of use in the evaluation of the radiological hazard from the accidental release of radioiodine. The experiments showed that deposition of inhaled iodine vapor is essentially complete at normal breathing rates and that a fall off in deposition is only apparent at respiratory rates well in excess of the normal range. Much of the iodine vapor inhaled by mouth is deposited in the oral pharynx. From this region iodine is carried down the oesophagus with saliva into the stomach and small intestine, where absorption occurs. Thyroid uptake and urinary excretion patterns were similar to those observed after ingestion of sodium iodide labelled with ^{132}I. (auth) (UK)

51343 THE METABOLISM OF RARE EARTHS. I. THE DISTRIBUTION AND EXCRETION OF INTRAVENOUS $^{152\ 154}Eu$ IN THE RAT. Berke, H. L. (Wayne State Univ., Detroit). Health Phys., 15: 301-12(Oct. 1968).

The distribution and excretion of $^{152-154}Eu$ were determined after intravenous injection of a single dose in the rat. Europium was quickly cleared from the circulation (1–2 days), most of it (60–80% being present in the plasma. Bone, liver and kidney accumulate most of the nuclide initially. The highest activity is in the bone, with a half time of 2.7 years for the slowly mobilized component. Soft tissues show a more rapid clearance pattern, the kidney retaining the highest activity levels. The half time for whole body clearance is about 40 days. Excretion occurred mainly via the feces, the fecal to urinary activity showing a value of about 3.0 after the initial 2 week period. Retention of the isotope in the whole body could be resolved into 2 exponential terms indicating half times of 4.4 days and 3.5 years. (auth) (UK)

51344 EFFECT OF AGE OF RECIPIENT MICE ON GROWTH AND DIFFERENTIATION OF TRANSPLANTED BONE MARROW CELLS. Davis, M. L.; Upton, A. C.; Cosgrove, G. E.; Satterfield, L. C. (Univ. of Tennessee, Knoxville. Oak Ridge National Lab., Tenn.). Proc. Soc. Exp. Biol. Med., 128: 1149-53(Aug.-Sept. 1968).

Female RFM/Un mice exposed at various ages to whole-body x radiation of 750 R followed by injection of syngeneic bone marrow cells showed a marked increase in megakaryocyte colonies in the spleen as the age of the mice at irradiation was increased from 30 to 72 weeks. A postirradiation splenic megakaryocytosis was also noted in a minority of similarly irradiated old mice that received no exogenous marrow cells. Hence, the megakaryocytes in the marrow-injected animals may be presumed to have been partially of host, as well as donor, origin. Variation in the age of the bone marrow donor over the same age range was without effect. The mechanism of the age-dependent megakaryocytosis in recipients remained to be determined. (auth)

51345 EFFECT OF DELADROXONE AND ESTROZEN ON ^{85}Sr RETENTION IN RATS AND MICE. Simmons, David J.; Cummins, Helen (Argonne National Lab., Ill.). Proc. Soc. Exp. Biol. Med., 128: 1102-6(Aug.-Sept. 1968).

Deladroxone, a long-acting progestogen, had no effect upon the whole body retention of ^{85}Sr in young rats and mice. Pretreatment of rats with Deladroxate, which contains Deladroxone plus estradiol enanthate, reduced by nearly 50% the 21-day retention of ^{85}Sr. However, when administered to mice in large doses after the ^{85}Sr was well fixed in bone, Deladroxate raised the retention 8 to 9%. The effects of Deladroxate in both species appeared to be due to its estrogen component. (auth)

51346 KINETICS OF THE DISAPPEARANCE OF GELATIN PROTECTED RADIOGOLD COLLOIDS FROM THE BLOOD STREAM. Cohen, Y.; Ingrand, J.; Caro, R. A. (CEN, Saclay, France). Int. J. Appl. Radiat. Isotop., 19: 703-5(Sept. 1968).

Studies of the biological distribution of intravenously injected ^{198}Au colloids indicated that they are localized preferentially in those organs which have a large number of reticuloendothelial cells, and principally in the liver, a fact which has been routinely used to determine liver blood flow, based on the kinetic model proposed by Dobson and Jones (1952). This model postulates that phagocytosis may be assimilated to a first order process with regard to the concentration of the colloid in the blood stream, and implies that the disappearance constant (k) and therefore the half-time of disappearance ($k = 0.693/T$) is independent of the initial concentration (c_0). The results of the present authors and others, however, appear to indicate that this assumption cannot be accepted in all cases. It is supposed that the phagocytosis follows, from the kinetic standpoint, a model similar to that proposed by Michaelis and Menten (Biochem. Z. 49: 333(1913)) for enzyme reactions. This model is applied to ^{198}Au sols with different particle sizes. It is shown that the velocity of disappearance (v) is equal to $k(N_{ep})$, where N_{ep} is the initial number of particles per kg of animal. The value of k was determined 1 min after injection, assuming a mixing time of that order. In order to prove the hypothesis experimentally the authors determined the rate of disappearance of different gelatin protected radiogold colloids in the rat; the results appeared to confirm the proposed model. It follows that the rate of phagocytosis is not influenced specifically by the size of the injected particles, at least in the range studied, and that the half-time of disappearance of the dispersions from the blood stream depends only on the number of injected particles per kg. of animal and not on its size. It was also found that T is >4 min when $N_{ep} > 10^{13}$ particles per kg. (UK)

51347 RADIO-ISOTOPE EXPERIMENTS WITH A THYROID CIRCULATION ANALOGUE. Kember, N. F. (Royal Free Hospital, London). Phys. Educ., 3: 250-2(Sept. 1968).

Experiments with a simple water-circulation system are stated to give a few insights into methods used and problems encountered in the applications of radioactive isotopes in medicine. (auth) (auth)

51348 ADEQUACY OF RADIOIODINATED TRIOLEIN FOR FAT TOLERANCE TESTS. Nutr. Rev., 26: 62(Feb. 1968).

Loss of radioiodine from radioiodinated fat in the intestine during fat absorption tests is briefly assessed. In 1963 it was discovered that commercially available radioiodinated triolein was contaminated by 30 to 60% of inorganic radioiodine and nonlipid iodinated products, so that the precision of previously performed absorption tests using iodinated triolein was in question. Since this time, pure radioiodinated triolein has become available, but doubts still exist about its biological stability. One report claimed that the halogenated fat was largely dehalogenated in the small bowel and colon, and that the test was therefore meaningless. In another study measurements were made of the absorption of radioiodinated triolein as compared with glyceryl-trioleate-^{14}C in rats. Determinations were made of the ratio of the two labeled trioleates in the gastrointestinal contents, cecum and colonic contents, feces, small intestinal wall, and thoracic duct lymph. Except for the last two sites, the ratio of the two was very close to one. There, however, only about 70% as much iodinated triglyceride was recovered as ^{14}C marker in the thoracic duct or the wall of the small bowel. It was concluded that loss of radioiodine did occur in formation of lymph, but not in the gastrointestinal lumen. Thus, radioiodinated triolein absorption can be considered a valid measure of steatorrhea, if purified ^{131}I-triolein is used as the test substance and stool radioactivity is used as the index. (BBB)

51349 THE DYNAMIC BEHAVIOR OF HASSALL'S CORPUSCLES AND THE TRANSPORT OF PARTICULATE MATTER IN THE THYMUS OF THE GUINEA PIG. Blau, J. N. (Guy's Hospital Medical School, London). Immunology, 13: 281-92(Sept. 1967).

Immature guinea pigs, seven to ten weeks old, were exposed to x rays directed solely to the thymus gland that received a tissue dose of 300 R. An intracardiac injection of 0.3 ml of India ink containing 10% carbon of uniform particle diameter was given. An increase in the number and size of Hassall's corpuscles was noted in irradiated thymus glands, simultaneously with an increase in the uptake of carbon in the walls of blood vessels and in perivascular macrophages. Within 12 hr of irradiation, Hassall's corpuscles contained carbon, at first in a finely stippled form in polymorphonuclear leucocytes and, later, in larger aggregates in macrophages. After 14 days Hassall's corpuscles disappeared and the lobules were repopulated with thymocytes. Migration outwards of carbon-laden macrophages occurred between the 14th and 21st days. In contrast, entry of carbon in control glands took place more slowly but retention of particulate matter in Hassall's corpuscles was still present after 56 days. It was suggested that Hassall's corpuscles were a graveyard for dead thymocytes, possibly for some effete circulating lymphocytes and in some circumstances for polymorphonuclear leucocytes. Antigens might localize in Hassall's corpuscles, and be mobilized and returned to the circulation by macrophage activity. (BBB)

51350 ACTIVITY OF ALANINE- AND ASPARTATE-AMINOTRANSFERASES IN SUBCELLULAR FRACTIONS OF THE BRAIN IRRADIATED BY X RAYS AND NEUTRONS OF MEAN ENERGIES. Pikulev, A. T.; Konyaeva, M. P.; Tkach, V. G. Ukr. Biokhim. Zh., 40: 250-3(1968). (In Russian).

A dose of 40 rad x radiation caused the activity of alanine-aminotransferase to increase in mitochondria of rat brain in two hours or a day and to decrease in the mielin fraction and supernatant fluid in two hours. The activity of aspartate aminotransferase decreased in mitochondria, mielin fraction, and supernatant fluid in two hours and increased in this fluid in a day. These data are compared with the investigation results obtained under the effect of neutrons of intermediate energies in a dose of 13.5 rad. It was concluded that the character of changes in activity of the transamination enzymes is determined not only by the dose but by the kind of ionizing irradiation. (auth)

51351 CONTENT AND INTENSITY OF PHOSPHOLIPID RENEWAL IN NORM AND RADIATION INJURY. Sopin, E. F.; Gaidai, V. M. (Kiev State Univ.). Ukr. Biokhim. Zh., 40: 297-302(1968). (In Russian).

The content and intensity of renewal of phospholipids and their separate fractions were studied in the muscles, liver, and brain of normal guinea pigs and during the terminal stage of radiation disease. The content of phospholipids in the muscles, liver, and brain definitely decreased at this stage. The intensity of renewal of phospholipids in the muscles and brain decreased in comparison with the normal animals and increased in the liver. The qualitative composition of phospholipids in all the tissues under investigation in radiation disease remained unchanged although their quantitative composition underwent some changes. The intensity of renewal of separate fractions was also liable to definite changes, but differed in different tissues. (auth)

51352 EFFECT OF ULTRAVIOLET RADIATION ON RIBONUCLEASE IN SOLUTIONS OF ETHYLENE GLYCOL. Komolova, G. S.; Belikova, E. V.; Egorov, I. A. (Inst. of Biochemistry, Moscow). Dokl. Akad. Nauk SSSR, 181: 241-4(July-Aug. 1968). (In Russian).

RNA enzyme was irradiated in water and in 52% ethylene glycol solution with ultraviolet radiation at doses of 5, 10, 15, and 20×10^3 joules/m^2. The residual activities of the enzyme in solution after the irradiation were found to be 76, 44, 28, and 17% respectively for the aqueous solutions. The same values were obtained for the irradiation in 52% ethylene glycol solution after dilution with water to allow for recovery of the enzyme conformation. The character of the differential absorption spectra was the same whether the irradiation of the RNAase was carried out in water or in 52% ethylene glycol. On irradiating the antifreeze solution of ribonuclease at 0° and −35°C, it was found that the residual ribonuclease activities were 46% at a dose of 10×10^3 joules/m^2 and 19% at a dose of 20×10^3 joules/m^2. The temperature decrease had no noticeable effect on the results of the experiment. (TTT)

51353 PROTEIN SYNTHESIS IN THE EARLY DEVELOPMENT OF THE GURNARD (SMALL FISH) AFTER RADIATION INACTIVATION OF THE NUCLEUS. Neifakh, A. A.; Krigsgaber, M. R.; Il'in, M. I. (Inst. of Developmental Biology, Moscow). Dokl. Akad. Nauk SSSR, 181: 253-6(July-Aug. 1968). (In Russian).

Protein synthesis was followed in relation to nuclear function by irradiating fish embryos at various stages of development with high x-ray doses (15 to 20 kr) which completely inactivated the genetic function. Protein systhesis was determined by incubating isolated blastoderms with labeled amino acids. On fertilizing irradiated eggs with irradiated sperm, embryos without nuclei were obtained. Division appeared normal in these embryos but development stopped at the stage of late blastula. These cells had hardly any chromosomes. X ray irradiation decreased m-RNA synthesis, and also protein synthesis. Immersion of the embryos in actinomycin also led to a decrease in protein synthesis. Up to 0 to 5.5 hours of development (middle blastula) irradiation decreased protein synthesis in a uniform manner. From 5.5 to 7.5 hours (late blastula) variations in protein synthesis were noted with higher assimilation of labeled amino acids at 7.5 hours as compared to 5.5 hours of development. The nuclei controlled protein synthesis during this period. This control lasted for a few hours up to the beginning of gastrulation. (TTT)

51354 CRITICAL RE-EVALUATION OF IMMUNOSUPPRESSIVE THERAPY IN CANINE RENAL ALLOGRAFTS. Diethelm, A. G.; Dubernard, J. M.; Busch, G. J.; Murray, J. E. (Harvard Medical School, Boston). Surg. Gynecol. Obstet., 126: 723-36 (Apr. 1968).

The effect of x irradiation in combination with several immunosuppressive drugs on kidney transplant rejection in dogs was studied. Three 150-R doses of x rays were given to the renal allograft on the 2nd, 4th, and 7th day after transplantation (450 R total). When the drugs were used alone, azathioprine was found to be the most effective immunosuppressive agent in treating dogs which had undergone renal allografts. Methyl prednisolone, combined with azathioprine, azaserine, and actinomycin C, provided the best combination of drugs to achieve longterm survival. The addition of local x-ray therapy to the renal allograft did not improve upon the effects of azathioprine, azaserine, or actinomycin C alone. The most common causes of death were rejection when immunosuppressive drugs were inadequate to suppress the immunologic response or infection secondary to excessive drug administration. (BBB)

51355 EPIDERMAL DIFFUSION BARRIER TO ^{133}Xe IN MAN AND STUDIES OF CLEARANCE OF ^{133}Xe BY SWEAT. Sejrsen, P. (Bispebjerg Hospital, Copenhagen). J. Appl. Physiol., 24: 211-16(Feb. 1968).

Diffusion of ^{133}Xe through the epidermis on the crus in man was studied by external monitoring. Xenon-133, dissolved in saline, was injected intracutaneously and the blood flow was arrested by a tourniquet. A diffusion barrier to ^{133}Xe in the middle one-third of the epidermis similar to that for water vapor was demonstrated. The barrier was localized by measuring the loss of ^{133}Xe out through the skin after removing the epidermal cells by successive strippings with adhesive plaster and by a special histological tech-

nique. The regeneration of the barrier was followed. The loss of ^{133}Xe out through the intact epidermis was demonstrated to be quite negligible in relation to clearance by blood flow under non-sweating conditions. The possibility of a considerable loss of ^{133}Xe by sweating was found. The nature of the barrier and the question of a diffusion limitation for other inert gases are discussed. (BBB)

51356 STUDIES ON IMMUNITY TO HEMONCHUS CONTORTUS INFECTION: THE ELIMINATION OF A CHALLENGE INFECTION BY IMMUNE SHEEP. **Bitakaramire, P. K. (Univ. of East Africa, Kabete, Kenya). Parasitology, 56: 619-22 (Nov. 1966).**

Adult sheep vaccinated against H. contortus infection with a double dose of x-irradiated larvae are highly immune to a challenge infection with normal larvae. This immunity was of the order of 98% as measured by worm counts at autopsy 30 days after challenge. How soon the host starts to eliminate a challenge infection after it has been given and the stage of the parasite against which the immune response is directed were examined. Suspensions of the larvae were treated with total x-ray doses of 40 KR. The fecal egg count was determined at weekly intervals starting from the day of the first vaccination, i.e., day−60. The feces of the vaccinated sheep were consistently negative after vaccination with 2 doses of 10,000 x-irradiated larvae. After challenge the sheep were autopsied before the challenge infection became patent. The results of the abomasal worm burdens at autopsy are shown. The sheep did not show clinical signs of disease at any time during the experiment. Thus, sheep previously vaccinated with 2 doses of x-irradiated larvae were shown to be almost completely immune when challenged with 50,000 normal larvae and subsequently autopsied 3, 6, 9, 12, and 16 days later. (BBB)

51357 IMMUNITY TO TRICHINELLA SPIRALIS. II. IMMUNITY PRODUCED BY THE ADULT WORM IN MICE. **Denham, D. A. (Cambridge Univ., Eng.). Parasitology, 56: 745-51 (Nov. 1966).**

It was shown that the 5th or adult stage of T. spiralis stimulates strong immunity in mice. This was shown using a transfer technique and irradiated worms. The larvae were x irradiated at a dose rate of 395 R/min for a total dose of 3750 R. The immunity produced by a single infection with 400 irradiated larvae was demonstrated. When killed and examined for muscle T. spiralis 28 days after infection, these mice harbored no larvae so that the irradiation had been successful in sterilizing the immunizing infection. Twenty-six days after the immunizing infection, mice were challenged with 400 normal larvae of T. spiralis. The challenge controls contained a mean of 5200 larvae and the immunized mice held only 1550 larvae, showing that they had a strong immunity. In a 2nd experiment the immunity produced by 2 infections with transplanted, irradiated adult worms was studied. It was shown that the 5th stage alone is capable of stimulating immunity. A comparison between the immunity produced by a normal infection and one with irradiated larvae is made and explanations offered to explain the fact that less immunity is stimulated by irradiated larvae. (BBB)

51358 STUDIES ON MANGANESE. III. THE BIOLOGICAL HALF-LIFE OF RADIOMANGANESE IN MAN AND FACTORS WHICH AFFECT THIS HALF-LIFE. **Mahoney, John P.; Small, Walter J. (Carney Hospital, Boston). J. Clin. Invest., 47: 643-53 (Mar. 1968).**

The biological half-life of ^{54}Mn and some factors influencing it were studied in man. The disappearance of ^{54}Mn from the body in normal subjects was described by a curve having 2 exponential components. An average of 70% of the injected material was eliminated by the slow pathway. The half-time characterizing this component showed a small variation in normal subjects and had an average value of 39 days. The half-time for the fast component also showed a small variation and had an average value of 4 days. In a normal subject with a low Mn intake due to a voluntary low caloric intake, the percentage of ^{54}Mn eliminated by the slow pathway increased to 84% and the half-time characterizing the pathway increased to 90 days. The half-time of the fast component was the same as for the normal group. Two months after initiation of the study in this subject, a large flushing dose of Mn markedly increased the ^{54}Mn elimination rate, which was described by a single exponential curve. A mildly Fe-deficient subject showed a marked decrease in the percentage of Mn eliminated by the slow pathway accompanied by a less dramatic decrease in the half-time characterizing this pathway. Oral Fe therapy, which corrected the mild anemia, caused a decrease in the elimination rate and the altered curve was described by a single exponential component. Preloading 2 subjects with Mn resulted in a great decrease in the fraction eliminated by the slow pathway with less effect on the half-time. A small but definite fraction of ^{54}Mn was incorporated into erythrocytes. The observations suggested an interrelation between Mn and Fe metabolism. (BBB)

51359 UPTAKE OF ^{90}Sr BY PLANTS IN RELATION TO SOME OTHER NUTRIENT ELEMENTS. **Ilina, G. V.; Rydkii, S. G.; Yanovskaya, F. G. (Moscow State Univ.). Agrokhimiya, 2: 83-92 (Feb. 1966). (In Russian).**

A 3-yr research program was carried out to determine the ^{90}Sr isotope uptake by wheat plants in connection with the interdependence between Sr and Ca, and also with respect to the effects of various conditions that absorbed minerals impose on the uptake of Sr by plants. It was found that the absorption of ^{90}Sr by plants depended on the pH of soils, a factor which also showed a considerable influence on the competitive action between Ca and Sr. Acid soils treated with Ca in the form of lime reduced the ^{90}Sr content of wheat plants. Soils treated with an acid salt, ammonium sulfate, increased the Sr content in the grain of growing wheat. Ammonium chloride added to soil also increased the Sr content in wheat kernels, while the admixture of $NaNO_3$ somewhat decreased the Sr content of wheat grain. Inevitably, the extent of Sr uptake by wheat plants depended on the Sr amounts in soil, but the rate was more varied in vegetative parts of wheat than in kernels. Wheat plants growing in a mildly acid soil, turflike podsol, accumulated less Sr in vegetative parts with increasing doses of Ca. A full substitution of Ca by Sr (in chloride form) in sandy soils had unfavorable effects on the growth and development of wheat plants, also on the weight of wheat kernels. (BBB)

51360 INITIATION OF PRIMARY ANTIBODY RESPONSES BY BOTH CIRCULATING AND NONCIRCULATING LYMPHOCYTES. **Strober, S. (National Cancer Inst., Bethesda, Md.). Nature (London), 219: 649-51 (Aug. 10, 1968).**

Several experiments were performed to test the ability of thoracic duct cells to restore the primary antibody response of sublethally irradiated rats to sheep erythrocytes, bovine serum albumin, and tetanus toxoid. The response of rats depleted of thoracic duct cells by duct drainage was studied. The hemolysin response of rats after injection of sheep red blood cells is shown graphically. When the injection was given 24 hr after 500 R whole body x-irradiation the response was absent. It was restored by 2.5×10^8 first day thoracic duct cells injected intravenously 2 hr after irradiation. Similar results were obtained with rats immunized to bovine serum albumin. With tetanus toxoid 500 R abolished the response, and injection of up to 1×10^9 thoracic duct cells did not restore it. In other experiments sublethally irradiated rats received intravenous injections of 10^8 dissociated spleen cells obtained from normal rats and from rats depleted of thoracic duct cells, followed by challenging with tetanus toxoid. Although normal spleen cells were effective in restoring the antibody response, spleen cells from rats depleted for 3 days were only partially effective and cells from rats depleted for 5 days were ineffective. Cells active in restoring response are probably lymphocytes. Cells that initiate the primary antibody response to antigens such as sheep red blood cells and bovine serum albumin are probably members of lymphocyte populations which continually circulate between blood and lymph; response to antigens such as tetanus toxoid is probably due to lymphocytes which are not members of circulating populations. (UK)

51361 RADIOSENSITIVITY OF THE MEMBRANES OF ISOLATED NUCLEI OF NERVE AND GLIAL CELLS. **Nadareishvili, K. Sh.; Dzhokhadze, D. I.; Kakhiani, E. D. (Inst. of Physiology, Tbilisi, USSR). Radiobiologiya, 8: 396-402 (1968). (In Russian).**

The kinetics of the hypotonic and alkaline decomposition of isolated nuclei obtained from the brains of four-week-old rats was studied. The nuclei were isolated by the method of Shobo with modifications. A suspension of nuclei in an isotonic sucrose solution was irradiated at 1.5−2°C, then diluted with 0.25% neutral or alkaline NaCl solution, and the kinetics of the decomposition of the nuclei determined at room temperature. The number of nuclei in suspension was counted both microscopically and with an electronic particle counter. The experiments indicated that a statistically significant radiation effect is detected at a dose of 500 R for nuclei of astrocytes and at 1000 R for the nuclei of neurons and oligodendrocytes. The rate of hypotonic and alkaline lysis of nuclei increases almost up to 30 kR. At a dose of 40 kR or more, the effect of irradiation is reduced, i.e., the osmotic stability of the nuclear membranes increases sharply. With all other conditions equal, the nuclei of the astrocytic glia are more sensitive to irradiation than the nuclei of the neurons and oligodendrocytes. (JPRS)

51362 STUDIES OF THE RELATION OF THE NUCLEUS-CYTOPLASM RATIO TO NUCLEAR SIZE. IV. THE EFFECT OF RADIATION INJURY AND HETEROLOGOUS RNA ON THE EPITHELIUM OF REGENERATING EXTREMITIES IN AMBY-

STOMA TIGRINUM GREEN. Kucias, J. (Katedra Biologii Ogolnej, Zagreb). Biol. Zentralbl., 86: 583-7(Sept.-Oct. 1967). (In German).

The sizes of nuclei and cells in histological sections (400 5 μ thick) of hind legs of axolotl larvae were measured 20 days after selective exposure to 8000 R of unfiltered x irradiation, given at a rate of 480 R/min. Ribonucleic acid was extracted from portions of the tissue samples. Nonirradiated and untreated samples of regenerating epithelium were obtained at 5 or 20 days after tissue sampling, and 25 or 40 days after irradiation. Some of the regenerating extremities were injected with ribonucleic acid. Statistical analysis of the results showed that the nuclear volume increased significantly after irradiation treatment, and the tissue 0 consumption rate decreased within 5 days of amputation and 25 days after irradiation. The cytoplasm : nucleus ratio and the absorption coefficient increased within 20 days after irradiation. The results also suggested that heterologous RNA was able to replace nonspecific ribosomal nucleic acid, with a possibility that exogenous RNA could be a source of energy for the cells. (BBB)

51363 SOME PROPERTIES OF HEAVILY IRRADIATED EHRLICH ASCITES TUMOR CELLS AND THEIR INFLUENCE ON THE HOST. Juraskova, Vera (Inst. of Biophysics, Brno). Brit. J. Cancer, 22: 63-9(Mar. 1968).

Morphological changes in heavily irradiated Ehrlich's ascitic tumor (EAT) cells after relatively long cultivation in irradiated homologous recipients and their ability to provoke anemia in the hosts were studied. Tumor cells were x irradiated with a 10,000-rad dose of γ irradiated (^{60}Co) with 100,000 rad before being injected into the peritoneal cavity of x-irradiated mice. Even the dose of 100,000 rad did not exert an immediate lethal effect on EAT cells under these conditions and 9 days later the surviving EAT cells were investigated histologically. Signs of typical post-irradiation degeneration were found and formations resembling seriously damaged mitoses were seen after radiation doses that greatly exceed those used by other authors. Development of anemia in mice that had been given EAT cells or the ascitic fluid intraperitoneally was also examined. Anemia was caused only in the irradiated recipients. Substances that are able to damage the red blood cells and/or blood vessels which are secreted by EAT cells into the ascitic fluid are postulated. Nevertheless, this impairment alone is not sufficient to cause anemia. Additional damage by whole-body irradiation, however, results in an earlier and greater anemia than that observed in only irradiated control mice. (BBB)

51364 IRRADIATED EXPERIMENTAL NERVE HETEROGRAFTS PRETREATED WITH SPECIFIC ANTISERUM. Hirasawa, Yasusuke (Kyoto Prefectural Univ.); Marmor, Leonard; Liebes, Dorothy. J. Neurosurg., 28: 233-40(Mar. 1968).

Cellular changes in the regional lymph nodes draining the sites of irradiated implanted heterografts in dogs, rabbits and rats were studied, as well as the effect on the response of the host to heterologous nerve pretreated with graft-specific antisera. Draining lymph node cell changes were correlated with the response of the rabbit immune serum to homologous nerve extracts by means of immunodiffusion plates. No lines of precipitation developed in double immunodiffusion plates, when sera from rabbits were removed after implantation and tested with extracts of nerves. Implants in rats at 1 week by gross examination of nonradiated nerve implants revealed considerable edema. Microscopic examination showed a moderate inflammatory reaction in the implant from the peripheral toward the central area. In contrast, treated nerve showed a minimal inflammatory reaction and slight edema. Dogs that received irradiated heterografts showed a good alignment with the peroneal nerve. In contrast, untreated grafts showed poor alignment of the graft at the distal end with neuroma formation. At 6 months the irradiated but not the control graft revealed an action potential, showing that there was excellent axon regeneration at the distal nerve. (TSS)

51365 FAILURE OF ^{109}Cd TO TRAVERSE SPERMATOGENIC PATHWAY. Gunn, Samuel A.; Gould, Thelma Clark; Anderson, W. A. D. (Univ. of Miami, Fla.). J. Reproduct. Fert., 16: 125-8(June 1968).

The uptake of ^{65}Zn and ^{109}Cd in mouse and rat testis and epididymis was studied. Twelve-week-old male mice received a single subcutaneous injection of 10 μCi of ^{109}Cd, and, in some mice, also cadmium chloride (0.012 mmole/kg) to produce testicular necrosis. Mice were killed at times varying from 1 hr to 6 weeks. With added Cd, maximal uptake was attained in testis between 4 hr and 1 day, by which time there was widespread vascular injury. The ^{109}Cd uptake diminished from 2 days to 1 week, and then was maintained constant from 2 to 6 weeks. Tissue ^{109}Cd levels (in percent administered dose) were slightly lower with the carrier than with the tracer dose (a reflection of dilution effect). With the tracer dose there was no damage and the maximal ^{109}Cd level attained in the testis by 1 day was maintained constant for 6 weeks. In 20-week-old male rats the vasa efferentia were severed unilaterally, thus interrupting the sperm transport pathway on one side, and immediately afterwards one group received 10 μCi of ^{109}Cd; the other group received 2 μCi (1.1 μg) of ^{65}Zn. On the intact side ^{65}Zn accumulated in the testis reaching a peak at 1 week; as testicular levels fell, ^{65}Zn rose in temporal sequence in caput, corpus, and cauda epididymidis. The distinct peaks of ^{65}Zn in the epididymis at 2 and 3 weeks reflected the transport of radioisotope by products of the testis since these peaks failed to appear on the side in which the vasa efferentia were severed. In sharp contrast to ^{65}Zn, ^{109}Cd showed no prominent peaks in either testis or epididymis; neither was there any difference in ^{109}Cd uptake on the side in which the sperm transport pathway was interrupted. (BBB)

51366 OBSERVATIONS ON THE DEPOSITION OF THOROTRAST IN RAT TISSUES. Simmons, David J.; Cummins, Helen; Nirdlinger, Edwin (Argonne National Lab., Ill.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 902-18(Aug. 1968).

Young growing rats were injected intravenously (tail vein) with colloidal thorium dioxide (thorotrast, 0.4 to 0.75 ml.) and the disposition of the material in the body was traced at various times after injection by autoradiographic techniques. In bone, the injected material was filtered from the blood and sequestered by macrophages in the marrow and intertrabecular regions. The distribution of these cells was nonuniform, and the autoradiographic pattern seemed to reflect growth processes. In the metaphysis of the long bone, the labeled cells formed a band of high activity which became further removed from the epiphyseal cartilages with time, due to continued endochondral ossification. The rate at which the bones of the thorotrast-treated rats grew in length was normal. Nevertheless, irregular foci of endochondral bone formation were observed due to the formation of plugs of degenerate cartilage in the growth cartilages during the first six weeks, and focal hypertrophy of endosteal bone occurred by 12 months. The etiology of the histologic change is obscure. (auth)

51367 EVIDENCE THAT THE DARK REPAIR SYSTEM OF COLIPHAGE T4 IS CONTROLLED BY THE VIRAL GENOME. Haber, Kai (Stanford Univ., Palo Alto, Calif.). Biochem. Biophys. Res. Commun., 23: 502-5(May 25, 1966).

Ultraviolet irradiation survival curves were determined for T4 and T2 phages grown on a uv-resistant and on a uv-sensitive Escherichia coli strain, to determine whether the v gene in T4, responsible for the production of a repair enzyme, e.g., an endonuclease capable of thymine dimer excision from T4 DNA, was merely parasitizing (inducing) the already existing excision repair mechanism of the bacterium or whether it was responsible for the de novo synthesis of a T4 dimer excision enzyme. The T2 and T4 bacteriophages in suspensions were irradiated at a distance of 42 cm from a GE G8T5 uv lamp (emitting chiefly at a wavelength of 2537 Å) for variable amounts of time and assayed on E. coli B/r and E. coli B_s. The results showed that there was no detectable difference in the survival curves of T4 on E. coli B/r that contains its own dimer excision enzyme or on E. coli B_s that lacks the dimer excision enzyme. Survival curves of T2 grown on each of the bacterial strains were used as controls, since the T2 contains no v gene. Comparison of the T2 and T4 curves demonstrated that there was decreased survival in the absence of the v gene. It was concluded that the v locus of T4 was responsible for the de novo production of a component of a reactivation system for uv-induced damage in the phage DNA. (BBB)

51368 RADIUM RETENTION IN MAN AFTER MULTIPLE INJECTIONS: THE POWER FUNCTION RE-EVALUATED. Miller, Charles E.; Finkel, Asher J. (Argonne National Lab., Ill.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 871-80(Aug. 1968).

The parameters proposed for the power function, $R = 0.54\ t^{-0.82}$, that were widely employed as a description of the retention of radium in humans, were recalculated. The new computation was based on a 33 yr span of data collected on eight patients who received radium by injection in 1931 to 1933, and who were studied in 1951 to 1953. In several cases the previously employed radium injection schedule was revised on the basis of information from original hospital records. The new analysis yielded average power functions of $R = 0.30\ t^{-0.44}$ for the complete series of eight patients and $R = 0.20\ t^{-0.36}$ for the five patients whose injection schedules are more reliably known. The individually fitted power functions for the eight patients ranged from $R = 0.15\ t^{-0.19}$ to $R = 0.98\ t^{-0.63}$. The retention of radium in humans after one yr had elapsed since administration can be expressed as well by a single

exponential term with a half-time of 14.98 yrs and an injected dose coefficient of 0.0246 as by the average power function. This single exponential term and the power function, $R = 0.20\ t^{-0.36}$, are equally satisfactory for estimating the total amount of radium that entered the bloodstream of these patients. (auth)

51369 HOMOGRAFT RESPONSE IN ADULT-THYMECTOMIZED MICE: DEFICIENCY WITH AGING AND AFTER LOW-DOSE RATE GAMMA IRRADIATION. Davis, W. E. Jr.; Cole, L. J. (Naval Radiological Defense Lab., San Francisco). Exp. Gerontol., 3: 9-17(Mar. 1968).

The homograft response of adult thymectomized mice was compared with that of intact controls late in life, and the late effects of x irradiation and low dose rate γ irradiation on the homograft responses were studied. The homograft response to skin grafts of varying antigenic disparity was measured at 15 to 20 months of age in mice thymectomized at 8 weeks of age. The response to male isografts was delayed more in thymectomized female recipients than in intact recipients. Exposure of female mice to sublethal x irradiation (at 10 to 11 weeks of age) resulted in a further delay in intact recipients and abrogated the response in the thymectomized recipients. Other intact but aged mice showed a slight impairment of response to skin grafts differing at non-H-2 loci. In thymectomized groups, this impairment was increased. Exposure of both intact or thymectomized mice (at 9 months of age) to 1133 rad of low dose rate γ radiation (1.4 rad/hr) resulted in an increased delay in response relative to the nonirradiated groups. In all cases, the non-H-2 grafts were the most affected by irradiation and thymectomy. It was concluded that (1) after adult thymectomy, the homograft response becomes deficient in old mice, particularly as regards male or non-H-2 isoantigens; (2) chronic γ irradiation after thymectomy further increases this deficiency, presumably by creating a greater demand for new immunocompetent cells and/or by eliciting defects in their precursors. (BBB)

51370 RENAL EXCRETION OF RADIOACTIVE MERCURY: EFFECT OF SUBSTANCES WITH A COMPETITIVE ACTION FOR CHLOROMERODRIN. De Simone, G. F.; Cardinale, A.; Brancato, G. (Univ., Palermo, Italy). Acta Isotop., 7: 181-7 (Dec. 15, 1967). (In Italian).

The results of studies in mice demonstrated that among sulfhydryl compounds and chelating agents there are drugs (dithiopropanol, cysteine, β-mercaptoethylamine, thioctic acid, EDTA) capable of accelerating renal excretion of ^{203}Hg-labeled mercurial diuretics, such as chlormerodrin. Measurements of radioactivity were made on equal amounts of homogenized cortical tissue by means of a well scintillator counter and also by macroautoradiographic and photodensitometric determinations. (auth)

51371 DISTRIBUTION OF THORIUM IN THE LIVER OF RATS DEPENDING ON THE ROUTES OF ADMINISTRATION AND CHEMICAL NATURE OF THE COMPOUND INTRODUCED. Makeeva, L. G.; Pavlovskaya, N. A.; Orlyanskaya, R. L. Med. Radiol., 13: 59-63(Sept. 1968). (In Russian).

The fractional distribution of ^{232}Th in the liver of rats depending on the route of introduction (complex and noncomplex) and time lapse after the isotope administration into the organism was studied. The liver was divided into fractions: acid-soluble, lipids, RNA, DNA, residual proteins, and nuclear proteins. The data demonstrated that thorium mainly binds with proteins and nucleic acids (89 to 94% of its quantity in the liver) irrespective of the route of administration. Chemical properties of the compound exerted a significant effect on the distribution and accumulation of thorium. The isotope content in the liver was greater with the administration of Th–EDTA than with introduction of noncomplex thorium compound. The nuclear fraction following the administration of a complex thorium compound was enriched by 50 to 200 times. (auth)

51372 BINDING OF PLUTONIUM AND AMERICIUM TO BONE GLYCOPROTEINS. Chipperfield, A. R.; Taylor, D. M. (Inst. of Cancer Research, Sutton, Eng.). Nature (London), 219: 609-10(Aug. 10, 1968).

The observation that Pu, Am and Y become localised in bone at sites which show histological evidence of the presence of mucosubstances prompted a study of the glycoproteins of bone and their metal binding properties. Gel filtration was used in a study of the binding of Pu and Am to bone proteins as compared with their binding to some other proteins. Solutions of ^{239}Pu(IV) and ^{241}Am(III) nitrates were employed in the studies. Experimental details are described and results tabulated for bovine γ globulin, human transferrin, human serum albumin, ovalbumin, bovine chymotrypsinogen, sperm whale myoglobin, bovine ribonuclease, cytochrome C, bone sialoprotein, chondroitin sulphate-bovine protein, and collagen. It was indicated that Pu binds more strongly to BSP and the chondroitin sulphate fraction of bone than to any of the other proteins examined. Am was found to bind fairly strongly to BSP, but less strongly to the chondroitin sulphate-protein fraction. Pu appeared to be bound much more strongly than Am by these two proteins. The results reflected the known stabilities of Pu-protein complexes, and supported observations suggesting that the stabilities of Am-protein complexes are in general much lower than for the corresponding Pu complexes. It may be of biological significance that both Pu and Am bind more strongly to bone glycoproteins than to collagen and transferrin, the latter being the protein which transports Pu and probably Am in the blood. The stronger binding of Pu as compared with Am may be of significance in connection with the greater carcinogenicity of ^{239}Pu compared with ^{241}Am. (UK)

51373 THE STUDY OF THE PHYSICOCHEMICAL STATE OF ^{90}Sr IN THE GASTROINTESTINAL TRACT. Frolova, E. I.; Dubrovina, Z. V.; Bakhareva, Z. A.; Burov, N. I. Byull. Eksp. Biol. Med., 66: 59-61(Aug. 1968). (In Russian).

The solubility of ^{90}Sr and its relation to the compounds in the gastrointestinal tract of pigs and rats at different time intervals after feeding and with various titers of calcium in the food was studied. It was found that the disappearance rate of ^{90}Sr from the upper segment of the gastrointestinal tract can be described by two exponentials. Solubility of ^{90}Sr administered with the food in the contents of the stomach and intestine of the pig was 30 to 50% and did not depend on the concentration of the calcium present. The ^{90}Sr in the filtrate of the contents differed with each segment of the gastrointestinal tract and depended on the concentration of calcium present in the medium. Addition of pectin and alginic acid to food decreased the solubility of ^{90}Sr and ^{45}Ca. Alginic acid affected mainly the solubility of ^{90}Sr. (auth)

51374 STUDIES WITH TSH–^{131}I: DISTRIBUTION IN NORMAL AND HYPOTHYROID RATS. Altschuler, N. (Atomic Energy Commision, Buenos Aires); Pisarev, M. A.; Mitta, A. E. A.; Orlando, C. A. Int. J. Appl. Radiat. Isotop., 19: 625-9(Aug. 1968).

Radioiodine labelled thyrotropin (TSH) was injected into normal and hypothyroid rats. The concentration of the ^{131}I radioactivity was measured at different times in several tissues: liver, kidney, thyroid, pituitary, ovary and Harderian gland. An important localization was observed in the liver and the kidney, mainly in the first minutes after administration. Control studies were performed with Na^{131}I and normal rats and the results obtained indicated that the values observed with TSH–^{131}I were due to the localization of the hormone or its metabolites. Physiological mechanisms involved in TSH metabolization are discussed. (auth) (UK)

51375 ACTIVITY OF CHOLINESTERASE IN SUBCELLULAR FRACTIONS OF THE BRAIN DURING X IRRADIATION. Khrypchanka, I. P.; Kharlashkina, N. R. Vestsi Akad. Nauk BSSR, Ser. Biyal. Navuk, No. 2, 92-4(1968). (In Russian).

The effect of x radiation in relatively small doses (40 R) on the cholinesterase activity in different subcellular fractions, obtained by differential centrifugation of homogenates of the brain in 0.25 M solution of saccharose, prepared in 0.01 M solution of tris-buffer (pH at 7.4), was studied. The tests were carried out one hr, one day, and 30 days after irradiation. The clearest and most statistically reliable changes were found in nuclear fractions and supernatant liquids that are connected with the redistributed ferments in the fractions studied. (tr-auth)

51376 HYGIENIC ASSESSMENT OF THE CHRONIC ACTION OF NATURAL URANIUM ON THE FUNCTIONING OF THE THYROID GLAND. Rezanov, I. I. (Scientific-Research Inst. of Sanitation, Moscow). Gig. Sanit., No. 8, 48-52(Aug. 1968). (In Russian).

The effects of uranium in the drinking water on the thyroid and parathyroid glands and the sexual maturation of female albino rats were studied. Results showed that following the long-term use of drinking water containing uranium at a concentration of 0.6 mg/l, the function of the thyroid gland was diminished and that of the parathyroid glands increased. There was a delay of the sexual maturation when the uranium content of water was at a level of 6 mg/l and more. (auth)

51377 PROTECTIVE ROLE OF Ca AND F IN FOOD AND WATER AGAINST ^{90}Sr EFFECTS IN RATS. Knizhnikov, V. A.; Grozovskaya, V. P.; Vlasov, P. A.; Belousova, O. I.; Sedov, V. V. Gig. Sanit., No. 8, 38-44(Aug. 1968). (In Russian).

The effect of ^{90}Sr administered per os in water in a dose of 2 μCi/g body weight was studied in experiments performed using 300 albino rats. The animals were divided into three groups. The control group received food containing calcium below the standard level, the 2nd group received three times as much calcium, and the 3rd group received the same amount of calcium in the food as the 2nd and besides drank water with a somewhat higher fluorine content (3 mg/l). The results showed that the animals that

were given additional calcium in food and especially those that were given both calcium and fluorine, lived longer than the animals of the control group. They also presented fewer symptoms of radiation disease and cancer of the oral cavity and osteosarcoma developed much later in the few cases that were observed. The ^{90}Sr content in the skeleton of the experimented animals during the test (470 days) was lower than that of the control animals. (auth)

51378 EFFECT OF IRRADIATED GLUCOSE SOLUTION ON MITOTIC CHROMOSOMES OF VICIA AND TRADESCANTIA. Ma, Te-hsiu (Smithsonian Institution, Washington, D. C.). Radiat. Bot., 8: 307-15(Aug. 1968).

Concentrated glucose solutions (20%) which had received 0.5–2.0 Mrad of γ rays (^{60}Co) were diluted to 2% and used to treat lateral roots of Vicia and adventitious roots of Tradescantia. Studies of the cell samples fixed at successive intervals through the mitotic cycle indicated early interphase to be the stage most sensitive to the treatment. Dosage effect was demonstrated in roots treated with fresh irradiated glucose solution for longer duration. Of the three main types of breakage induced by irradiated glucose solution, centromeric and secondary constrictional breaks were more prevalent, and they were caused by long-lived radiolytic derivatives of glucose; chromatid breaks were relatively infrequent, and they were caused by short-lived radiolytic derivatives. A comparative study on the centromeric breakage rates between Vicia and Tradescantia confirmed that the centromeric breaks occurred preferentially in metacentric chromosomes. Control groups treated with non-irradiated glucose solution for 6 hr showed a higher rate of centromeric and secondary constrictional breaks than a baseline control which received no treatment. (auth) (UK)

51379 DOSE-DEPENDENCE OF THE RAPID REAPPEARANCE IN BLOOD OF VERY SMALL INTRAVENOUS DOSES OF ^{75}Se-SELENITE. Oldendorf, William H. (Veterans Administration Center, Los Angeles. California Univ., Los Angeles). Int. J. Appl. Radiat. Isotop., 19: 411-14(April 1968).

When sodium selenite (^{75}Se) was injected intravenously into rabbits in very small doses, and blood concentrations were followed for several hours, a rapidly falling concentration was seen initially. At 40–60 min a minimum level was reached. When a sufficiently small amount of selenium was administered, its level in blood rose in 2–3 hr to a higher level than that present five minutes after injection. This return to blood was not seen when larger amounts of (^{75}Se) were injected. The study indicates that the mechanism responsible for this reappearance exhibits saturation with selenium doses above 1–2 micrograms per kilogram. Attention is directed to the amount of selenium injected since quite divergent results could be obtained with different specific activities. (INIS) (UK)

51380 HYGIENIC INVESTIGATION OF THE EFFECT PRODUCED BY SMALL CONCENTRATIONS OF URANIUM ON THE HUMAN BODY. Novikov, Yu. V.; Pushkina, N. N.; Tambovtseva, A. M. (Scientific-Research Inst. of Hygiene, Moscow). Gig. Sanit., No. 6, 39-44(June 1968). (In Russian).

Data are presented on the effect produced by small concentrations of uranium (0.04 to 0.05 and 0.002 to 0.004 mg/l) in drinking water on such biological indexes of man as the blood content of hemoglobin and leukocytes and aminonitrogen, the blood catalase, aldolase, and prothrombin activity, the sulfhydryl groups, the thermal coagulation of blood serum, 17-ketosteroids of the urine, and vitamins C, B_2, B_1, PP, and pyrotartaric acid. No significant differences could be detected in these indexes among persons living in a region where the uranium content of water was at a level of 0.04 to 0.05 and 0.002 to 0.004 mg/l. Examination of the protein fraction of the blood serum by means of paper electrophoresis revealed certain differences in the value of albumin-globulin coefficient. Data obtained in experiments performed on animals did not confirm the observations made on the shifts noted in the protein fractions of men occurring under natural conditions, which cannot be referred to the action of small uranium concentrations. (auth)

51381 HYDROGEN–DEUTERIUM EXCHANGE REACTIONS CATALYSED BY NITROGENASE. Kelly, M. (Univ. of Sussex, Brighton, Eng.). Biochem. J., 109: 322-4(Sept. 1968).

Previous work in this field is summarised, and evidence is presented that nitrogenases from various systems differ in their ability to catalyse the exchange. The enzyme systems from Azotobacter chroococcum, A. vinelandii and Clostridium pasteurianum were used in the studies, and also nodules of alder (Alnus glutinosa) and the legume Medicago lupulina. The exchange reactions were carried out in Warburg flasks, attached to a mass spectrometer. Results are discussed. (UK)

51382 ATRAUMATIC LOCAL LABELING OF SKIN BY INERT GAS: EPICUTANEOUS APPLICATION OF ^{133}Xe. Sejrsen, Per (Bispebjerg Hospital, Copenhagen). J. Appl. Physiol., 24: 570-2 (Apr. 1968).

In an attempt to apply the principle of the local clearance of radioactive inert gas to the study of the blood flow in the cutaneous tissue, an atraumatic technique was developed for local labeling of the skin. Intracutaneous injection of ^{133}Xe dissolved in saline showed some evidence of provoking cutaneous hyperemia. The hyperemia was indicated by an observed weak flush reaction and by an initial fast clearance rate of the isotope even when very small amounts were injected. A method for nontraumatic labeling of the skin with ^{133}Xe by epicutaneous application is presented and a comparison of the results obtained by this method to those obtained by the local injection method was made. Xenon-133 in isotonic saline solution, with a sp act. of 1.0 mCi/ml, was injected intracutaneously. An amount of 0.003 ml of ^{133}Xe solution was injected in 3 min. (BBB)

51383 EFFECTS OF EXTERNAL CALCIUM AND SOME METABOLIC INHIBITORS ON BARIUM-INDUCED TENSION CHANGES IN GUINEA PIG TENIA COLI. Karaki, Hideaki; Ikeda, Miyoshi; Urakawa, Norimoto (Tokyo Univ.). Jap. J. Pharmacol., 17: 603-12(Dec. 1967).

Rat, guinea pig, and rabbit ileum and rat uterus respond to Ba ion by contracting in the absence of external Ca. The relation between Ba-induced tension development and external Ca was re-examined using isolated tenia coli preparations. Concentrations of 0.01 to 0.1 mM Ba caused periodic contractions and more than 0.5 mM induced a tonic response in tenia coli. Unlike results in other preparations, 0.5 mM Ba had no effect on tenia coli when the external Ca was removed. With a higher concentration (20 mM) of Ba, a small part of the contracture was not dependent on external Ca although the greater part of Ba-induced tension development seemed dependent on the external Ca. Barium had little capacity to substitute for the role of Ca in the development of K-induced tension in tenia coli. The need for the existence of a nondepolarized membrane for Ba-induced tension development is suggested. Factors which abolished the K-induced tonic response also abolished the Ba-contracture. Anoxia, glucose removal, and dinitrophenol (DNP) 1×10^{-4} M abolished the tonic response and Ba produced only a phasic response, the same phenomenon as seen in K contracture. Lithium substitution and ouabain (2.5×10^{-6} M) abolished Ba contracture in a pattern different from that observed in K contracture. Removal of external K from the medium also abolished Ba contracture in similar manner as seen with ouabain. It is concluded that Ba-induced tension development is generally dependent on external Ca, that Ba-induced tension development is inhibited by some metabolic inhibitors, and that factors which inhibit the development of Ba contracture can be divided into 2 groups, that is, DNP type and ouabain type, according to the pattern of inhibition of the contracture. (BBB)

51384 URINE PROTEINS DURING ACUTE RADIATION SICKNESS OF ANIMALS. Zedgenidze, G. A.; Kashkin, K. P.; Kulish, Yu. S. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 354-61(1968). (In Russian).

The urine proteins of intact rats of the August line and animals subjected to whole-body irradiation by the γ rays of ^{60}Co, were subjected to an electro- and immunoelectrophoretic investigation, where cross-exhausted and unexhausted rabbit immune sera against uroproteins of intact and irradiated animals, as well as against proteins of the blood, mitochondria, microsomes, and hyaloplasm of kidney cells, were used to develop the electrophoretograms. In the uroproteins of the intact rats, six fractions differing in electrophoretic mobility were detected, containing 11 antigens, five of which were represented by blood serum proteins, while six were uroproteins specific for the urine, also determined in the proteins of the hyaloplasm and microsomes of kidney cells. Radiation sickness of the animals is accompanied by phase changes in the kidney function, where an increased excretion of protein with the urine is observed at the early stage of development of radiation sickness and during the height of the disease in cases of autoinfectious complications. The change in the kidney function in each case proceeded in two steps, the first of which is characterized by a change in the activity of processes of excretion, a decrease or disappearance of part of the specific uroproteins from the urine, and the appearance of certain supplementary kidney antigens among the urine proteins. At the second stage there is an increase in the permeability of the kidney tubules with increasing content and spectrum of excreted serum proteins in the urine. The results of an immunochemical investigation of the urine proteins can serve as an important criterion for a differential evaluation of the excretory and filtration capacities of the kidneys, both in the case of radiation sickness and in other pathological states. (JPRS)

51385 INFLUENCE OF GALASCORBIN ON THE RESPIRATION AND OXIDATIVE PHOSPHORYLATION OF LIVER MITOCHONDRIA AFTER IRRADIATION OF ANIMALS. Shamrai, E. F.; Dzyubko, N. Ya.; Baran, L. A.; Sudarikova, L. G. (Kiev Roentgenoradiological and Oncological Inst.). Radiobiologiya, 8: 362-5(1968). (In Russian).

In radiation sickness, disturbances of the intracellular metabolism are observed, including the energy metabolism, lying at the basis of all the vital processes. The question of the influence of ionizing radiation upon the processes of tissue metabolism and oxidative phosphorylation has been insufficiently studied. We were interested in determining the indices of the energy metabolism after various types of irradiation (local and total) and various doses (subiethal and lethal), as well as determining the possibility of influencing these processes by the use of a physiological complex of vitamins C and P, galascorbin. (auth)

51386 RADIOACTIVITY OF THE RINGED SEAL. Sokolova, N. V.; Parchevskii, V. P. (Pacific Ocean Scientific Research Inst., Magadan, USSR. Inst. of the Biology of the Southern Seas, Sevastopol). Radiobiologiya, 8: 460-2(1968). (In Russian).

Data on the strontium-90 and cesium-137 content in various organs and tissues of the ringed seal Pusa hispida ochotensis Pall. from the Sea of Okhotsk in 1966 are presented. The strontium-90 concentrations in the bones of the seal were 13-28 pCi/kg of crude weight, in the muscles—0.6-1.5, and in the liver—1.1-1.4. The γ radiation of the seal organs and tissues was attributed chiefly to potassium-40 and cesium-137. (JPRS)

51387 STUDIES ON COLLOIDAL CHROMIC PHOSPHATE: AN IMPROVED METHOD OF PREPARATION AND IN SITU PRECIPITATION BY INJECTION OF PAPAIN. Anghileri, L. J. (Institut fuer Nuklearmedizin, Heidelberg). Int. J. Appl. Radiat. Isotop., 19: 415-20(April 1968).

The effects of the concentration of the reagents and the gelatine on the radiochemical yield of colloidal chromic phosphate-^{32}P were studied. Precipitation "in situ" by the action of papain was assayed 1 day and 7 days after intraperitoneal and intrapleural injections. Injection of papain before the colloid showed better results. Counting of the organs and scanning of the radioactivity indicate better localization in the cavity with less migration to the liver. (INIS) (UK)

51388 INFLUENCE OF IRRADIATION ON THE COMPOSITION OF MESSENGER RNA DURING EARLY LOACH EMBRYOGENESIS. Umanskii, S. R. (Inst. of Biological Physics, Pushchino, USSR). Radiobiologiya, 8: 347-53(1968). (In Russian).

The population of RNA in normal and irradiated loach embryos was compared at various stages of development by the method of artificial DNA-RNA hybridization. It was shown that the activation of new genes during early loach embryogenesis is accomplished periodically. The periods of activation of the genes coincide with the periods of morphogenetic activity of the nuclei. Irradiation before the beginning of gene activation almost entirely suppresses this process, at the same time without producing a repression of already active genes. (JPRS)

51389 EFFECTS OF SODIUM HYPOCHLORITE, OZONE, AND IONIZING RADIATIONS ON THE PYRIMIDINE CONSTITUENTS OF ESCHERICHIA COLI. Prat, R.; Nofre, Cl.; Cier, A. (Centre de Recherches du Service de Sante des Armees, Lyon). Ann. Inst. Pasteur, 114: 595-607(May 1968). (In French).

The pyrimidine bases of E. coli nucleic acids were markedly modified by the action of sodium hypochlorite, ozone, and ionizing radiation. After NaClO treatment, the pyrimidine bases were chlorinated, principally cytosine and to a lesser degree, uracil and thymine; after perchloric acid hydrolysis appreciable quantities of 5-chlorocytosine and 5-chlorouracil were obtained. The reactivity of the pyrimidine bases with ozone was different, the thymine being more sensitive to O_3 than cytosine and uracil. Irradiation was carried out in an inert atmosphere or in the presence of oxygen at doses of 1 to 100 Mrad and a dose rate of 25 Krad/min. The dose-dependent disappearance of the 3 bases was much greater in an oxygen atmosphere. The order of the degree of alteration of the bacterial pyrimidines, in the absence of oxygen, was thymine > uracil > cytosine; in the presence of air the order was thymine > cytosine > uracil. Thus, thymine was the most sensitive pyrimidine in the bacterial nucleic acid. (BBB)

51390 EXAMINATION OF BARIUM–CALCIUM ANTAGONISM IN HEARTS AND SMOOTH-MUSCLE ORGANS OF THE EDIBLE SNAIL (HELIX POMATIA L.). Erdelyi, L. (Jozsef Attila Univ., Szeged, Hungary). Acta Biol. Acad. Sci. Hung., 19: 11-22(1968).

The action of Ba^{++} ions on the tonus-stimulatory and other effects on heart function and its antagonism by Ca^{++} ions were studied. Similar antagonism could be observed in isolated fragments of intestine and organs of the reproductive system. With three kinds of organs, highly different amounts of $CaCl_2$ were necessary to compensate the effect of 1 mg/ml $BaCl_2$, chosen as the unit concentration. The same was valid for the compensation of the barium-induced changes in other parameters (tonus, frequency, amplitude). The compensative effect of $CaCl_2$ was considerably influenced by seasonal factors, probably as a consequence of the natural changes in Ca^{++} concentration in the physiological state (states of rest and activity), and of the consecutive adaptation of tissues. If the antagonistic component ($CaCl_2$) was added to the medium one min after adding $BaCl_2$, the experiment could be repeated with nearly identical results two or more times (reversible reaction) on the same preparation. After three-min action however, the effect was irreversible. Pretreatment with hexamethonium did not influence the development of the barium-calcium antagonism in the isolated heart, but did in fragments of intestines and organs of the reproductive system. The barium-calcium antagonism was similar to potassium-calcium antagonism. (BBB)

51391 INFLUENCE OF MICRORAYS ON THE FIBRINOLYTIC ACTIVITIES OF STREPTOKINASE AND STREPTODORNASE. Szirmai, Endre; Hajdukovic, Srdjan (Inst. of Nuclear Energy, Stuttgart). Acta Med. Okayama, 21: 161-6(Aug. 1967).

The effect of γ and microwave irradiation on various fibrinolysin preparations was compared. Varidase and streptokinase-streptodornase (SK-SD) were given γ-ray doses of 2000 and 5000 R, and Varidase 2400 MHz irradiation at 20 to 30 W intensity. Thromboelastography was used to study the effect of Varidase on blood clotting and fibrinolysis before and after irradiation. Clotting time of recalcinated plasma, thrombin clotting time, fibrinolytic activity on nonheated fibrin plates, and the autocoagulogram were also determined. The effect of microwave irradiation was similar to that of 2000 and 5000 R γ irradiation. It did not substantially affect the activity of fibrinolysin (SK-SD). By the irradiation method used it was demonstrated that the fibrinolytic activity of anticoagulant in the SK + SD preparation was retained in all the clotting systems tested. These findings indicate that it is safe to irradiate patients for therapeutic purposes with microwaves provided that provision is made for maintenance of clotting factors in the blood. (BBB)

51392 ORIGIN AND KINETICS OF MONONUCLEAR PHAGOCYTES. van Furth, Ralph; Cohn, Zanvil A. (Rockefeller Univ., New York). J. Exp. Med., 128: 415-35(Sept. 1, 1968).

The origin and turnover of different populations of mouse mononuclear phagocytes were described. Mononuclear phagocytes were defined as mononuclear cells that are able to adhere to glass and phagocytize. In vitro labeling studies with thymidine-^3H showed that monocytes in the peripheral blood and peritoneal macrophages do not multiply and can be considered end cells in a normal, steady state situation. However, the mononuclear phagocytes of the bone marrow appear to be rapidly dividing cells. This conclusion was supported by in vivo labeling experiments. A peak of labeled mononuclear phagocytes of the bone marrow was found 24 hr after a pulse of thymidine-^3H. This was followed, 24-hr later, by a peak of labeled monocytes in the peripheral blood. From these experiments it was concluded that the rapidly dividing mononuclear phagocytes of the bone marrow, called promonocytes, are the progenitor cells of the monocytes. Labeling studies after splenectomy and after x irradiation excluded other organs as a major source of the monocytes. Peak labeling of both the blood monocyte and peritoneal macrophages occurred at the same time. A rapid entry of monocytes from the blood into the peritoneal cavity was observed, after a sterile inflammation was evoked by an injection of newborn calf serum. These data led to the conclusion that monocytes give rise to peritoneal macrophages. No indications were obtained that mononuclear phagocytes originate from lymphocytes. In the normal steady state the monocytes leave the circulation by a random process, with a half-time of 22 hr. The average blood transit time of the monocytes has been calculated to be 32 hr. The turnover rate of peritoneal macrophages was low and estimated at about 0.1% per hour. On the basis of these studies the life history of mouse mononuclear phagocytes was formulated to be: promonocytes in the bone marrow, → monocytes in the peripheral blood, →macrophages in the tissue. (auth)

51393 MUTATION TESTS ON DROSOPHILA USING IRRADIATED CARBOHYDRATE SOLUTIONS. Munoz, Enzo Ruben; de Mazar Barnett, Beatriz K. (Comision Nacional de Energia Atomica, Buenos Aires). Food Irradiat., 8: No. 3, 58-60(Jan.-Mar. 1968).

In connection with the wholesomeness studies of irradiated foodstuffs, gamma irradiated solutions of fructose and sucrose were injected into Drosophila melanogaster males to investigate their possible mutagenic effect. When sex-linked recessive lethals were scored in spermatozoa and spermatogonia, the

frequencies of mutations observed did not prove statistically significant. (auth)

51394 CELLULAR DIFFERENTIATION OF THE IMMUNE SYSTEM OF MICE. I. SEPARATE SPLENIC ANTIGEN-SENSITIVE UNITS FOR DIFFERENT TYPES OF ANTI-SHEEP ANTIBODY-FORMING CELLS. Shearer, G. M.; Cudkowicz, G.; Connell, Mary St. James; Priore, R. L. (Roswell Park Memorial Inst., Buffalo). J. Exp. Med., 128: 437-57(Sept. 1, 1968).

Spleen cell suspensions of unprimed donor mice containing precursors of immunocytes were transplanted into x-irradiated recipient mice. In the presence of antigen (sheep erythrocytes) these precursors, called antigen-sensitive units, gave rise to progeny cells secreting specific antibody. The production of cells releasing IgM hemolysins (direct plaque-forming cells), IgG hemolysins (indirect plaque-forming cells), and hemagglutinins (cluster-forming cells) was studied quantitatively. It was found that each of these immunocyte populations was distinct, i.e., that cells releasing agglutinins did not, as a rule, release hemolysins, and vice versa, and that cell populations secreting IgM hemolysins did not shift, under certain experimental conditions, to the production of IgG hemolysins during the primary immune response. By transplanting graded numbers of spleen cells, the number of antigen-sensitive units that reached the recipient spleen was limited. The frequency of antigen-sensitive units in donor cell suspensions was estimated and the cells were tested for their potential for production of immunocytes of more than one type. Results indicated that antigen-sensitive units were unipotent, for they displayed in the spleens of unprimed donors the same restrictions of function and heterogeneity (antibody-specificity differentiation, antibody-class differentiation) found among antibody-forming cells. Furthermore, antigen-sensitive precursors for direct plaque-forming cells, indirect plaque-forming cells, and cluster-forming cells were detected in the spleens of unprimed mice in different frequencies. It was concluded that relatively advanced differentiation of potentially competent cells occurs before sheep erythrocyte administration. The relevance of this finding for the broad spectrum of immunologic reactivities and for the heterogeneity of antibody responses to given antigens is discussed. (auth)

51395 EXPERIMENTAL STUDIES ON THE EFFECTS OF X RAYS ON THE INHIBITION OF THE IMMUNOLOGIC REACTION IN THE COURSE OF LAMELLAR INTRACORNEAL KERATOPLASTY. Kozuchowska, Izabela; Staszyc, Jozef (Ophthalmologic Clinic, Lublin). Klin. Oczna, 36: 477-80(1966). (In Polish).

Studies were conducted on 24 rabbits weighing 2.5 to 3 Kg, under general urethane anesthesia, subjected to lamellar intracorneal keratoplasty. In the first of three groups, each rabbit received a foreign-body, lamellar, intracorneal transplant, previously x-irradiated with a single dose of 10, 20, 40, 50, 60, 100, 120, or 150 R. After 12 to 14 days an additional graft was made with nonirradiated material. In the second group, the order of nonirradiated and irradiated transplants was reversed. In the third group the cornea of each rabbit received a single x-ray dose as in the other two groups, whereupon a nonirradiated, foreign-body, lamellar, intracorneal transplant was made. It was found that a loss of transparency of transplants in the first group (two out of eight rabbits after 10- and 20 R doses) and in the second group (three out of eight after 10-, 20-, and 30 R doses) occurred most often within three weeks after operation, as a result of the immunologic reaction of host tissues to the donor graft. This was observed in transplants previously x-irradiated or nonirradiated; however, the irradiated grafts induced a milder reaction. The irradiation of rabbits, as in the third group, suppressed the immunologic reactions, indicating a decreased sensitivity of the recipient to the transplanted homologous tissue. (BBB)

51396 RADIATION-INDUCED LETHALITY AND DNA STRAND BREAKAGE: THE RELEVANCE OF THE OXYGEN EFFECT. Alper, Tikvah (Hammersmith Hospital, London). Int. J. Radiat. Biol., 14: 83-4(1968).

A discussion of recent literature concerning the oxygen enhancement ratio pertaining to single and double strand breaks in DNA is presented. The effects of oxygen enhancement on irradiated dry and wet bacterial spores and plant seeds are pointed out. A model relating lethal damage in bacteria to primary events in DNA is discussed. Results of experiments demonstrate an inverse correlation between oxygen enhancement ratio and radiosensitivity. (H.L.W.)

51397 HAEMOLYTIC DISEASE IN NZB MICE AND IN NZB–CBA RADIATION CHIMAERAS. Polackova, Marta; Strejcek, J. (Inst. of Experimental Biology and Genetics, Prague. Charles Univ., Prague). Folia Biol. (Prague), 14: 185-92(1968).

A series of NZB mice was examined throughout the life-span by the direct Coombs test for antibody against erythrocytes in order to obtain information on the onset and dynamics of the autoimmune hemolysis that is a characteristic of the hemolytic anemia found in NZB mice. Autoantibodies were not detectable in 100% of the animals until the 14th month of life (56 to 59 weeks) and there were frequent reversions to negative Coombs reactions in 5 to 6-month-old animals that had been repeatedly Coombs positive. No sex differences in the onset of the autoantibody production were observed. The antinuclear factor was demonstrated in the serum of 53% of 8- to 11-month-old NZB mice. Its presence was, however, revealed at the same age in mice of the following strains: C57BL/10ScSn, B10.D2, and the outbred stock H. Mortality, which was observed in the NZB mice, reached almost 100% at 17 months of age and was not in correlation with the severity of the disease. Transfer of spleen cells from adult Coombs positive donors into newborn NZB mice failed to render the latter Coombs positive. An attempt was made to find out whether and to what extent a genetically normal host environment can modify the expression of a presumably genetic aberration of transferred lymphoid cells and vice versa. CBA.T6T6 mice, clinically healthy or sick NZB mice and (NZB × CBA.T6T6)F_1 hybrids were used in various combinations as donors and recipients of curative bone marrow inocula after potentially lethal γ irradiation. The autoantibody production was examined in all donors and recipients prior to and after the irradiation and transfer of cells. Bone marrow cells from NZB Coombs positive donors in genetically healthy CBA.T6T6 recipients did not behave autonomously and no anti-red cell antibodies were detected in the normal environment. In the reciprocal combination the number of Coombs positivities gradually disappeared after transfer. In a group where cells of NZB negative donors had been transferred into syngeneic NZB positive recipients, the resulting chimeras were Coombs positive. The results seem to suggest that, in addition to the specific genetic aberration, some factors controlled by the residual NZB genotype are necessary for the given autoimmune condition to be manifested. (auth)

51398 INCLUSION AND DISTRIBUTION OF RADIOACTIVE ^{133}Xe IN THE ANIMAL ORGANS AND TISSUES. Mirtov, A. V.; Taratukhin, V. R.; Peschanskii, K. I. Med. Radiol., 13: 64-6 (Sept. 1968). (In Russian).

Investigations conducted on rabbits showed that the uptake of ^{133}Xe in the organs and tissues occurs with a diverse rate. These differences are more marked after 25 to 30-minute inhalation of gas. A mathematical model of ^{133}Xe uptake by organs and tissues of experimental animals is presented. Differences in the total content of radioactive gas in some tissues of animals were demonstrated. (auth)

51399 INCREASE OF DNA FRAGMENTS WITH AN INCREASE IN THE NUMBER OF GC-PAIRS AFTER IRRADIATION OF PEA SEEDS. Tokarskaya, V. I.; Nelipovich, P. A. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 938-9(1967). (In Russian).

Pea seeds received 20 kR from ^{137}Cs at 700 R/min and were steeped in water for 16 to 24 hrs, after which the germ was removed and the DNA separated. DNA preparations from irradiated and control seeds were chromatographed and the DNA fractions thermally denatured. The results showed that a certain amount of the DNA underwent degradation as a result of which fractions appeared which were eluted by salt at a low concentration. Those low molecular weight fragments melted at a higher temperature than unfractionated DNA, which was characteristic of parts of the DNA molecule with a high GC-content. Thus after irradiation fragments with a high content of GC-pairs of nucleotides accumulated in DNA. (JPRS)

51400 EFFECT OF 20 μc ^{131}I DOSES OF PROTEIN-BOUND IODINE CONCENTRATIONS IN SERUM. Bell, T. K.; Mackay, J. S. (Royal Victoria Hospital, Belfast). J. Nucl. Med., 9: 263 (June 1968).

The content of protein-bound iodine-127 in the blood serum from patients undergoing routine thyroid investigations was measured just before the oral administration of 20 μCi of ^{131}I and 48 hr after the administration of ^{131}I. No significant differences in the content of protein-bound iodine-127 were found in blood serum 48 hr after administration of ^{131}I. (C.H.)

51401 FREE RADICAL PROCESSES IN THE CELL ORGANELLES OF IRRADIATED ANIMALS. Kozlov, Yu. P.; Danilov, V. S.; Arkhipov, A. S. Biol. Nauki, No. 4, 64-8(1967). (In Russian).

The kinetics of radiation injury and the spectral properties of homogenates and cell organelles of rat liver were studied by the methods of chemiluminescence and electron paramagnetic resonance. Irradiation with doses of 200, 600, and 1,500 R produced characteristic changes in the homogenates, mitochondria, and lysosomes that could be recorded by chemiluminescence and electron paramagnetic resonance. After irradiation the lu-

minescence of the homogenates, nuclei, and mitochondria increased sharply and then returned to normal. The luminescence of the homogenate of the irradiated liver increased markedly during the first 24 hours, whereas the luminescence of the nuclei and mitochondria intensified within a few hours of irradiation. The fact that the early changes following irradiation occurred at the subcellular level was confirmed by the electron paramagnetic resonance spectra that showed slight changes in the homogenates and obvious ones in the nuclei and mitochondria. The luminescence of the organelles and homogenates increased in proportion to the radiation dose. (JPRS)

51402 SUGAR RETENTION, COFACTOR LEVELS, AND LEAKAGE OF METABOLITES IN X-IRRADIATED, STARVED YEAST CELLS. **Doyle, R. J.; Spoerl, Edward (Army Medical Research Lab., Fort Knox, Kentucky). Radiat. Res., 34: 326-34 (1968).**

Measurements to clarify the factors responsible for a higher rate of CO_2 production by x-irradiated starved yeast cells (Saccharomyces cerevisiae) than by unirradiated cells gave the following results: In sugar transport experiments, irradiated cells retained a greater portion of sorbose-^{14}C, though rates of efflux were similar during a first phase of exit and rates of uptake were similar; irradiated cells contained more thiamine pyrophosphate than unirradiated cells, whereas pyruvate decarboxylase activities and ATP and DPN contents were similar; similar amounts of 260-mμ-absorbing materials were lost by irradiated and unirradiated cells during starvation; incubation with glucose or maltose increased the total loss, while incubation with less readily metabolized sugars increased the relative loss from irradiated cells, and higher doses of radiation did not greatly affect cell membrane stability as measured by turbidimetric changes in cells suspended in sugar solution. It was concluded that differences in transport capacity and permeability were not primarily involved in the difference in capacity to produce CO_2, but that the thiamine pyrophosphate content and the capacity of the cells to bind or compartment sugar appear to be directly related and are directly or indirectly affected by x irradiation. (auth)

51403 STUDY OF THE DISPERSION AND FLIGHT RANGE IN ANOPHELES SERGENTI THEO. IN SIWA OASIS USING RADIOACTIVE ISOTOPES AS MARKERS. **Abdel-Malek, Albert A. (Cairo Univ); Abdel-Aal, Motamed A. Bull. World Health Organ., 35: 968-73 (1966).**

Techniques for labeling mosquitos and detecting them are described. Late third-stage and early fourth-stage larvae were bred in radioactive solutions. The radioisotopes used were ^{32}P, as $NaH_2{}^{32}PO_4$, and ^{35}S, as $Na_2{}^{35}SO_4$. Concentrations of 15 μCi of ^{32}P or 35 μCi of ^{35}S per l of distilled water in the breeding pans were found to give rise to high enough levels of radioactivity in the emerging adults to be easily detected by autoradiography. Detection of labeled mosquitos by an autoradiographic technique was as follows. The collected mosquitos were spread out on cellulose tape that was applied to strips of x-ray film in a dark-room and left in the cassettes for four days. Labeled mosquitos produced an image on the film, the two isotopes used being distinguished by energy discrimination. Both isotopes were β emitters but had different energies of radiation: ^{32}P is a hard β emitter with an energy of radiation of 1.71 MeV, while ^{35}S is a soft β emitter with an energy of 0.165 MeV. The ^{32}P-labeled mosquitos produced diffuse fogging on the x-ray film, while ^{35}S-labeled mosquitos gave a well-defined image. Results of these experiments carried out at Siwa Oasis established that the males dispersed up to 3.4 Km and the females up to 2.5 Km from the points of release. (BBB)

51404 THE CONTAMINATION OF GRASSLAND WITH RADIOACTIVE STRONTIUM. II. EFFECT OF LIME AND CULTIVATION ON THE LEVELS OF ^{90}Sr IN HERBAGE. **Ellis, F. B.; Mercer, E. R.; Milbourn, G. M. (Agricultural Research Council Radiobiological Lab., Wantage, Eng.). Radiat. Bot., 8: 269-84 (June 1968).**

The effects of applying lime to permanent pastures, and of replanting them, on the contamination of herbage with radioactive strontium were studied in field experiments under a wide range of conditions in the United Kingdom. In accordance with the findings in other investigations, the results suggest that about one quarter of the radioactive strontium deposited on established pastures is likely to be retained on edible tissues. This material is subsequently lost from the foliage at an exponential rate, about half the material present being removed every two weeks in the ensuing 1 or 2 months. After this initial period the contamination of herbage is largely controlled by uptake from the plant base rather than from the cumulative total in the soil. The extent to which the contamination of pasture with strontium-90 might be lowered by liming or replanting under different circumstances is considered. It seems unlikely that the exposure of the population to radiation would be greatly modified by such measures. (auth) (UK)

51405 UPTAKE OF GOLD BY MARINE SPONGES. **Bowen, H. J. M. (Univ. of Reading, Eng.). J. Mar. Biol. Ass. U. K., 48: 275-7 (June 1968).**

Gold was determined in six marine sponges by neutron activation analysis and the results compared with ^{198}Au uptake of the sponges. Sea water was labeled by adding $NH_4{}^{198}AuCl_4$, so that each ml was enriched with about 10^{-8} of Au and gave about 250 counts/sec on a 5 × 5 cm NaI crystal employed as a scintillation counter. For activation analysis, samples of dried sponge, 0.2 g, were placed in Al-foil packets together with 10^{-6} g Au standards, and were exposed to a flux of 2×10^{12} neutrons cm^{-1} sec^{-1} for 48 hr. The induced radioactivity (mostly ^{56}Mn and ^{24}Na) was then allowed to decay for 24 hr. Each sample was dissolved in 5 ml aqua regia + 1 ml perchloric acid after adding 25 mg inactive Au carrier (as NH_4AuCl_4). After distilling off the aqua regia and destroying the organic matter, the samples were taken up in hydrochloric acid and shaken with ethyl acetate. The ethyl acetate was washed and evaporated with concentrated hydrochloric acid. The solution was diluted in 3M hydrochloric acid, and zirconium nitrate and sodium dihydrogen phosphate added. The precipitate was removed, and the supernatant treated with sulfur dioxide to precipitate Au metal. The amounts of Au found (1.8 to 12.6×10^{-8} g/g dry sponge) were higher than expected from measurements of the distribution of ^{198}Au between sea-water and dead sponge samples. (BBB)

51406 BINDING OF SULFHYDRYL REAGENTS TO NORMAL AND IRRADIATED LEUCOCYTE LYSOSOMES. **Harris, J. W. (Univ. of California Medical Center, San Francisco). Aust. J. Exp. Biol. Med. Sci., 46: 209-17 (Apr. 1968).**

Lysosomes of leucocytes are highly reactive in situ, undergoing explosive rupture during phagocytosis, and are relatively radiosensitive in the isolated state. The possibility that these properties might be related to membrane sulfhydryl groups was investigated by studying the binding of ^{203}Hg-labeled $HgCl_2$ and p-chloromercuribenzenesulfonate to granules isolated from rabbit peritoneal exudate neutrophils. Leucocyte lysosomes had a maximum Hg-binding capacity of 1.92×10^{-7} mole/mg protein (7.5×10^{-17} mole per granule). p-Chloromercuribenzenesulfonate binding at 6.6×10^{-4}M was similar to this figure, but at lower concentrations binding of the mercurial was 25% less than that of Hg. Isolated granules were highly sensitive to Hg and p-chloromercuribenzenesulfonate, undergoing rapid disruption upon incubation at 28° in the presence of low concentrations of these agents. At high concentrations of Hg (but not of p-chloromercuribenzenesulfonate) the granules became increasingly resistant to rupture. Lysosomes were more sensitive to γ irradiation when they were irradiated in the presence of 10^{-5}M $HgCl_2$, indicating that sulfhydryl groups may be involved in the radioinduced rupture of the granules. (BBB)

51407 EXTRACTION AND X-RAY DENATURATION STUDIES OF SPONGE AND HYDRA DNA. **Mookerjee, Anjali (Presidency Coll., Calcutta). Sci. Cult. (Calcutta), 34: 105-8 (Mar. 1968).**

Methods of extracting DNA from Hydra vulgaris and cells of the fresh-water sponge, Ephydatia meyeni, are described. Denaturation of DNA was carried out using x radiation and acetic acid. Typical uv absorption curves of non-irradiated, irradiated, and acid denatured DNA solutions are presented. Relatively large amounts of RNA were found in the hydras. Results indicate that there is a progressive increase in the disruption of hydrogen bonds as determined from the increase in the extinction coefficient with increasing doses. (H.L.W.)

51408 NOTE ON THE ANALYSIS OF NUTRIENT BROTH BY NEUTRON ACTIVATION ANALYSIS. **Lambert, J. P. F.; Simpson, R. E. (Food and Drug Administration, Washington, D. C.). J. Ass. Offic. Anal. Chem., 51: 999-1002 (Sept. 1968).**

The determination of trace elements in a neutron-activated sample of nutrient broth was limited by the presence of NaCl. The gamma-ray spectra accumulated from the activated samples were dominated first by Na and Cl, and then by Br, Cs, and Rb. Consequently only Na, Cl, Br, Rb, and Cs were definitely determined. Upper limits were calculated, using the accumulated spectral data, for the remaining requested elements. Separation techniques, along with sample condensation, could be employed to resolve further the elemental structure of this sample if needed. (auth)

51409 IMMUNOGENETIC AND IMMUNOLOGICAL PROBLEMS OF ALLOGENEIC HEMOPOIETIC RADIOCHIMERAS IN MAN. **Mathe, G.; Schwarzenberg, L.; Amiel, J. L.; Schneider, M.; Cattan, A.; Schlumberger, J. R.; Tubiana, M.; Lalanne, Cl. (Institut Gustave Roussy, Villejuif, France). Scand. J. Haematol., 4: 193-216 (1967).**

Whole-body irradiation and allogeneic bone marrow grafting in 21 leukemic patients are described. All patients, suffering from acute lymphoblastic leukemia, were irradiated using ^{60}Co,

the first 6 patients with a source of 1800 Ci delivering 3 to 4 rad/min and the others by 2000-, 3000-, or 4000-Ci sources delivering between 5 and 6 rad/min. The total dose, divided in 2 equal sessions separated by 24 hr, varied between 793 and 950 R (mean 825 R). Several bone marrow transfusions were given to each patient under conditions that are described. Failure of the graft occurred in 6 cases; the grafts took in 15 cases. All of these 15 cases were complicated by the secondary syndrome that was fatal in 11 cases but controlled in 4 cases. The immunogenetic and immunological features of the establishment and development of hematological radiochimeras in man are discussed. The choice of donor was fundamental. Three tests were considered to be most effective in donor selection: the indirect histocompatibility test (the so-called third man test), the leucocyte antigen test, and the reaction of donor and recipient leucocytes in the skin of an irradiated hamster. When marrow from several donors was transfused, the recipient spontaneously selected that which was closest genetically. It seemed likely that there was more chance of finding a suitable donor among genetically related than unrelated subjects. The frequency of graft take seemed to be slightly less in recipients who had previously received blood transfusions. Bone marrowing graft was associated with specific tolerance toward donor tissues, paralleled by the production in the chimera of immunoglobulins by the graft. The secondary syndrome seemed, as in animals, to be related to the graft-vs-host reaction. Various manifestations of this reaction were readily controlled, such as the hepatitis or erythrodermia associated with infiltration and proliferation of immunologically competent cells from the graft, but the immune insufficiency against micro-organisms, especially viruses and Candida albicans, was less amenable to treatment. (BBB)

51410 EVIDENCE FOR REPAIR REPLICATION OF HeLa CELL DNA DAMAGED BY ULTRAVIOLET LIGHT. Cleaver, J. E.; Painter, R. B. (Univ. of California, San Francisco). Biochim. Biophys. Acta, 161: 552-4(July 23, 1968).

After uv irradiation of HeLa cell cultures a medium containing tritium-labeled bromouracil deoxyriboside was added to the cultures and they were incubated for 3 hr. The DNA was isolated for density gradient analysis. The density gradient profiles from control and irradiated cultures are presented in the form of graphs. Results showed that HeLa cells can insert nucleotides into their DNA in response to irradiation, and that after irradiation most cells may begin to repair their damaged DNA even though all may not survive. (H.L.W.)

51411 THE MOLECULAR SIZE OF THE CALCIUM-TRANSPORT ATPASE OF SARCOTUBULAR VESICLES ESTIMATED FROM RADIATION INACTIVATION. Vegh, Klara; Spiegler, Peter; Chamberlain, Craig; Mommaerts, W. F. H. M. (Los Angeles County Heart Association. Univ. of California School of Medicine, Los Angeles). Biochim. Biophys. Acta, 163: 266-8(Sept. 17, 1968).

Sarcotubular vesicles were prepared from rabbit muscles and irradiated with electron beams from a 6 MeV accelerator. Preparations from four different rabbits were used. The ATP-splitting by the basic ATPase and the Ca^{++}-ATPase was a rectilinear function of time. The initial burst was inactivated with increased dose. Target sizes of ATPase based on data from experiments on radiation inactivation are tabulated. The target sizes for the basic ATPase and the Ca^{++} activated ATPase are not significantly different. (H.L.W.)

51412 MEMBRANE ENZYME SYSTEMS. MOLECULAR SIZE DETERMINATIONS BY RADIATION INACTIVATION. Kepner, G. R.; Macey, R. I. (Univ. of California, Berkeley). Contract AT(11-1)-34. Biochim. Biophys. Acta, 163: 188-203 (Sept. 17, 1968).

Classical radiation target theory is applied to radiation inactivation data on lyophilized membranes to obtain values for the molecular weights of membrane-bound enzymes. A molecular weight of 250,000 is estimated for the $(Na^+ + K^+)$-activated ATPase (ATP phosphohydrolase, EC 3.6.1.3) of human erythrocyte ghosts, guinea pig kidney cortex microsomes of plasma membrane preparations, and crayfish nerve cord. Other results suggest that the Mg^{2+}-dependent ATPase and the $(Na^+ + K^+)$-ATPase have the same molecular weight. Studies with a K^+-stimulated microsomal alkaline phosphatase (orthophosphoric acid monoester phosphohydrolase, EC 3.1.3.1) indicate a molecular weight of 140,000 for this enzyme which is thought to be responsible for the dephosphorylation step in the hydrolysis of ATP via the ATPase via the ATPase system. The volume fraction of the red cell membrane devoted to active cation transport is estimated at 0.002–0.04%. Microsomal and plasma membrane preparations apparently contain the same $(Na^+ + K^+)$-ATPase judged by their similar responses to ouabain inhibition, cation stimulation, and radiation inactivation. Radiation inactivation estimates of the molecular weight of acetylcholinesterase (acetylcholine acetylhydrolase, EC 3.1.1.7) and of mitochondrial ATPase are also presented. Studies with intact red cells and ghosts, irradiated while frozen, suggest that it might be possible to estimate the molecular weight of enzymes in intact cells. (auth)

51413 ROLE OF HOST FACTORS IN MOUSE TROPHOBLASTIC TISSUE GROWTH. Koren, Zeev; Abrams, Gerald; Behrman, S. J. (Univ. of Michigan, Ann Arbor). Amer. J. Obstet. Gynecol., 100: 570-5(Feb. 15, 1968).

To evaluate the possibility that the maternal environment might be responsible for controlling trophoblastic invasion and growth, an experiment was performed wherein defensive and immunologic responses of trophoblast recipients were suppressed by a lethal dose of whole-body x irradiation in C57BL/6J and A/HeJ mice. The total doses were 750 to 800 R. Transplantation of fertilized ova was performed two to 24 hr after irradiation. Every two days, from the sixth day after transplantation and up to the 17th day, groups of animals were examined. The growth of trophoblast in irradiated animals was frequently accompanied by retroperitoneal and/or intraperitoneal hemorrhage. No extrarenal hemorrhage was observed in nonirradiated animals. The nodules of trophoblastic tissue surrounded by hematoma in irradiated animals were two to five times larger than in nonirradiated animals. Up to eight days after transplantation there was no microscopically apparent difference in trophoblastic growth in irradiated as compared to nonirradiated groups. At 10 days, however, the sections from irradiated recipients contained two to three times the number of trophoblastic cells seen in nonirradiated subjects. Degenerative cytologic changes were more pronounced in the trophoblast in nonirradiated mice at 10 days. Furthermore, as late as 16 days after transplantation, trophoblast could still be found in irradiated animals, while in nonirradiated animals the nodules could no longer be identified grossly. In the nonirradiated animals, the nodules were bordered by a zone of slight fibroblastic proliferation and variable inflammatory cellular infiltration. In the irradiated mice this cellular reaction was definitely diminished. The results suggested that the immunologic and environmental state of the host was a major factor in the growth, proliferation, and life-span of trophoblastic tissue. (BBB) (TSS)

51414 RADIATION AND CONTROL OF THE IMMUNE RESPONSE. Kozinets, G.; Duplan, J. F. Bull. Cancer, 54: 366-8 (July-Sept, 1967). (In French).

Recent studies in the field of immunization and radiation effect on it are reviewed and some general observations made. Biochemical changes undergone by an antigen in its passage through phagocytes can be altered by irradiation. This fact may be very important in modification of immune reactions induced by x rays. In the rat, immune tolerance can be produced by such small doses of an antigen (flagella of Salmonella) that they are undetected by the electron microscope. This method could facilitate determination of a human level of tolerance for histo-compatibility antigens. Comparative immune response are discussed. In mice 24 hr after whole-body irradiation of 950 R, no immunoglobulins have disappeared entirely. Evidently, lymphoid cells can, under certain conditions, synthesize antibodies without previously dividing. The importance of thymus cells and bone marrow cells in immunization is stressed, and methods of cell restoration are discussed. In monkeys, fetal liver cells can be grafted in the irradiated tissues, but usually secondary disease, i.e., reaction of the graft, produces a similar reaction, certain cells in the blood acting as a warning signal. Keeping the bone marrow cells at 37°C before injection helps to reduce rejection of grafts. In irradiated rats, treated by allogenic bone marrow, a sizable number develop myelofibrosis which sometimes extends to sclerosis of all the bone marrow. Tissues irradiated with doses from 10,000 to 30,000 R undergo changes that cause rejection of irradiated isografts. (BBB)

51415 SELECTIVE IRRADIATION OF LYMPH NODES WITH TRANSITORY LIGATION OF THE THORACIC DUCT AS IMMUNOSUPPRESSIVE MEASURE IN RENAL TRANSPLANTATION. Shikata, Teaguo (Kyoto Univ.). Tohoku J. Exp. Med., 94: 55-61 (Jan. 1968).

A method of destruction of lymphocytes by irradiating lymph nodes with colloidal ^{198}Au to prevent homograft rejection in kidney transplantation was developed. The method was tested in dogs before being used on 6 patients. Doses of 0.2 to 0.5 mCi/Kg were used. After temporary clamping of the thoracic duct at the venous angle, ^{198}Au was injected into lymphatic vessels on the dorsal side of both feet. By this method, the mesenteric lymph nodes were also blocked so that ^{198}Au in only small amounts entered the blood stream. The clamp was released 24 hr after the injection. Peripheral lymphocytes began to decrease on the 4th day of injection, and one week later attained a level of 0 to 2%. Clinical data showed that a lymphocyte level of 7 to 8% was maintained even after 6 months. Among other blood parameters, only γ-globulin levels

were decreased in parallel with the lymphocyte counts. This safe and simple method can reduce the dose of immunosuppressants needed to block rejection to a minimum and prolong the survival of either experimentally or clinically transplanted kidneys. (BBB)

51416 FURTHER STUDIES OF ANTIGEN STIMULATION OF DEOXYRIBONUCLEIC ACID SYNTHESIS IN RABBIT SPLEEN CELL CULTURES. I. THE EFFECTS OF CENTRIFUGED PROTEINS. Harris, G.; Cramp, W. A. (Univ. of Birmingham, Eng.). Immunology, 14: 409-14(Mar. 1968).

The rate of DNA synthesis, as measured by the uptake of ^{14}C thymidine by spleen cell suspensions from rabbits previously immunized to heterologous proteins, was specifically stimulated by the deposits obtained after highspeed centrifugation of solutions of these antigens. The deposited material was much more stimulatory than the original protein or the supernatants from centrifuged preparations. Recombination of the centrifuged deposit with the supernatant resulted in restoration of the lost stimulatory activity. Macrophages, x irradiated with doses as high as 2000 rad or killed by heat, still stimulated responsive cells when primed with antigen, but extracts of cells, primed in vivo or in vitro, and prepared in saline or in phenol were always nonstimulatory in this system. From these results it was concluded that the role of macrophages was to trap antigen and present it on their surface membranes to the responsive cell population. Also studied were the effects of irradiating albumin solutions with 1000 krad on its uptake by mcarophages in vitro, and the ability of albumin after irradiation in solution to stimulate the rate of DNA synthesis in spleen cells. A dose of 10,000 krad inhibited DNA synthesis to about $1/6$ the normal level. (BBB)

51417 STUDIES IN QUANTITATIVE AUTORADIOGRAPHY, WITH PARTICULAR CONSIDERATION OF SPECIAL EVALUATION TECHNIQUES. I. Herrmann, W.; Hartmann, G.; Baumbach, H. (Institut fuer Angewandte Radioaktvitaet, Leipzig). Atompraxis, 14: 346-9(Aug. 1968). (In German).

Methods for quantitative autoradiography that permit determination of surface activity with an accuracy of 90%, using calibrated curves or calibrated surface preparations are described. (auth)

51418 SYNTHETIC ACTIVITY OF PRIMORDIAL GERM CELLS IN NORMAL AND IRRADIATED NEONATAL MALE RATS. Lett, I. C. (Birmingham Univ., Eng.). J. Embryol. Exp. Morphol., 19: 239-48(Apr. 1968).

The 100 R x irradiation of the testes of rats at birth inhibited the division of gonocytes but did not prevent them from differentiating into transitional cells. The latter, however, failed to divide to form spermatogonia type A, but increased markedly in size so that by eight days post partum the testes of irradiated animals contained numerous giant transitional cells destined to degenerate. The metabolic activity of germ cell nuclei in normal and irradiated rats was studied by autoradiography, using radioactive precursors of DNA, RNA, and protein. The results demonstrated that synthetic processes continue in cells whose division was blocked. The synthesis of RNA was largely unaffected by irradiation. DNA synthesis may be prolonged after exposure, but the amount of ^{3}H-thymidine incorporated by the nucleus declined from five days post partum and did not keep pace with nuclear growth. The synthesis of nuclear protein, on the other hand, increased from five days after irradiation and the quantity of phenylalanine taken up by giant cells seemed to be proportional to nuclear size. Thus the accumulation of nuclear protein appeared to be the main factor in nuclear enlargement. (BBB)

51419 COMPARISON OF THE ^{45}Ca LOSS IN ISOLATED RAT DIAPHRAGMS IN Ca-FREE AND NORMAL TYRODE SOLUTION. Lahrtz, Hg.; Luellmann, H.; Reis, H. E. (Univ., Kiel). Arch. Gesam. Physiol., 300: 120-8(Apr. 8, 1968). (In German).

The tissue Ca content and the ^{45}Ca level were determined in isolated rat diaphragm using a spectrofluorimetric method for Ca and liquid scintillation counting for ^{45}Ca. Isolated pieces of rat diaphragm incubated in ^{45}Ca-containing Tyrode solution reached equilibrium in about 15 min. Under the conditions used, only about 20% of the cellular Ca was exchanged with ^{45}Ca. The ^{45}Ca loss was markedly delayed in a Ca-free medium, although a net loss of tissue Ca occurred simultaneously. This was noted with normal diaphragm as well as with chronically denervated muscle. In denervated diaphragm a depolarization by high K concentrations enhanced the delay of ^{45}Ca loss still more. The results are interpreted as follows: a small labile Ca fraction of the mammalian skeletal muscle becomes attached more firmly during excitation or depolarization, while the net Ca loss is supplied by a fraction that is tightly bound under normal conditions. (BBB)

51420 INCREASE BY DIPHTHERIA AND TETANUS ANTIBODY TITERS BY ASSOCIATION OF IRRADIATION AND A BOOSTER INJECTION. Loiseleur, J. (Institut Pasteur, Paris). Ann. Inst. Pasteur, 112: 247-9(Feb. 1967). (In French).

The action of x irradiation combined with a booster shot on the formation of antibodies was studied in guinea pigs after action of x rays on the initial formation of antibodies was observed. Irradiation took place 13 days after 1 ml of diphtheria and tetanus toxoid injection; two days later another injection was given and one month later titers were determined. The nonirradiated control group showed 0.1 unit of diphtheria antibody and 0.01 unit of tetanus antibody, while animals receiving 60 R of whole-body x irradiation showed 0.1 to one and 0.01 to one unit, respectively. Those irradiated with 100 R over one foot showed three to five and 0.1 to one units, respectively. Thus x irradiation caused a 1000% increase in antibody titer when used during the initial period. In the second experiment, 340 guinea pigs were given toxoid injections two weeks apart; $2\frac{1}{2}$ months later a booster shot was given. Animals were divided into three groups; nonirradiated control animals and others irradiated with 50 R over the whole body or with 1000 R on one leg. One month later the titers were determined. Nonirradiated controls showed one to three units of diphtheria antibody and five to 10 units of tetanus antibodies. The group that received 50 R showed three to five units (diphtheria) and 10 to 30 units (tetanus); those receiving 100 R had 60 units and 20 units respectively. It was concluded that a considerable antidiphtheria and antitetanus immunity was attained when irradiation was combined with a booster injection. (BBB)

51421 EFFECT OF X RADIATION ON BIOLOGICAL ACTIVITY OF TRANSFER RNA. Skinner, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). J. Physiol. (London), 197: 51P(July 1968).

When aqueous solutions of uncharged transfer ribonucleic acids of liver, yeast and E. coli origin were x irradiated, their acceptor activities for leucine, phenylalanine, and lysine were inhibited to different extents. Both initial rate and final extent of acceptance were reduced. The extent of inhibition was a function of dose and was less for irradiation in nitrogen than in air. Lysine acceptor activity showed the greatest sensitivity in transfer (t)-RNA from all three sources. When uncharged liver t-RNA exposed to 50 Krad was tested for ability to transfer ^{14}C-L-lysine to polylysine in the presence of poly A and a liver ribosomal system, the inhibition observed was about 50%. Results indicated radiation damage to regions associated with transfer function as well as to acceptor sites. By irradiation of lysine-^{14}C-charged t-RNA it was possible to show that both the ribosomal binding site and the anticodon region were sensitive to ionizing radiation. (BBB)

51422 EXPERIENCES ON LABELLING WHOLE PLANTS WITH ^{14}C. Sauerbeck, D.; Fuehr, F. (Univ., Bonn. Kernforschungsanlage, Juelich, Ger.). pp 391-9 of Report of the FAO/IAEA Technical Meeting, International Soil Science Society Brunswick-Voelkenrode, 9-14 September 1963. Oxford, Pergamon Press, 1966. (JUL-389-LW).

Experiments with a simple and inexpensive ^{14}C growth chamber are described. It was not possible to raise small grain up to maturity at specific activities of 300 $\mu c/g$ C and above. Of several plant species tried at 1 mc/g C only maize grew fairly well; even this exhibited some radiation injury symptoms. A perfectly uniform labeling within the plant can only be obtained if the plants are exposed to ^{14}C O_2 of constant specific activity from the earliest seedling stage for at least several weeks. (auth)

51423 ALTERATIONS INDUCED BY ROENTGEN RADIATIONS ON THE PROTEIN PICTURE OF ALBINO RAT PULMONARY TISSUE. Bobbio Pallavicini, E.; Slaviero, E. G. (Univ., Pavia, Italy). Minerva Radiol., 13: 217-22(Apr. 1968). (In Italian).

An examination was made of the electrophoretic behavior of cellular soluble proteins of control rat lungs and of the lungs of rats x-irradiated with different doses. In general, a slight percentage reduction in proteins migrating with serum albumins was observed whereas it was not possible to evidence similar behavior in the γ globulins. The results obtained were compared with those of previous similar investigations on serum, bone marrow, liver, and lymphoid tissues and are discussed. (auth)

51424 EFFECT OF TIME ON DISTRIBUTION OF INJECTED RADIOSTRONTIUM IN THE SKELETON OF YOUNG PIGS. Anderson, John J. B. (Univ. of Illinois, Urbana). Health Phys., 15: 237-41(Sept. 1968).

The skeletal distribution and whole-body retention of ^{85}Sr by two pigs intravenously injected with 1 μCi at 2 days age was determined when the pigs were killed 24 and 50 days after injection. Both the distribution, which was non-uniform, and retention, were found to be time-dependent. Analysis of individual bones for percent of injected dose (I.D.) of ^{85}Sr per gram of calcium revealed marked changes in the ranking of different bones after 24 and 50 days. The tibias and fibulas, skull and mandible, scapulas, and ribs and sternum ranked highest with values around 0.9% of I.D. per g Ca at

50 days, whereas other bones ranked highest at 24 days. The skull and mandible, however, retained the largest percent (over 30%) of the remainder of the dose as compared to other parts of the skeleton. The age-dependent distribution pattern appears to reflect the normal physiologic growth processes of resorption and accretion. (auth) (UK)

51425 THE IRRADIATION OF SOME GLYCINE-CONTAINING DIPEPTIDES ON SILICA GEL. **Rivett, D. E.; Wilshire, J. F. K. (CSIRO, Melbourne). Photochem. Photobiol., 6: 867-74(Dec. 1967).**

The action of uv light on some peptides was examined. When glycylphenylalanine was irradiated on a thin layer of silica gel G with an Hg vapor lamp for 20 hr, evidence of a photochemical reaction was furnished by the detection of 7 products, which were identified as glycine, phenylalanine, glycylphenylalanine (starting material), 2, 5-diketopiperazine (glycine anhydride), 3,(6)-benzyl-2,5-diketopiperazine (glycylphenylalanine anhydride), 3,6-dibenzyl-2,5-diketopiperazine (phenylalanine anhydride), and N-acetylphenylalanine. The photochemical processes involved and the products formed during the irradiation of glycylphenylalanine on silica gel G are shown schematically. The irradiation of phenylalanylglycine on silica gel was also studied and a pattern of 7 spots, including phenylalanylglycine, was obtained. The remainder of the pattern was almost identical with that found for the irradiation of glycylphenylalanine, with the exception that N-acetylphenylalanine was replaced by a spot of higher R_f value. It seemed likely that the unknown spot was that of the deamination product of phenylalanylglycine, namely 3-phenylpropionylglycine ($C_6H_5CH_2CH_2CONHCH_2COOH$). This compound when synthesized was found to have the same chromatographic mobility in three solvent systems as the unknown compound. The results from both irradiations indicated that the photochemical reactions occurring during the irradiation of the two peptides on silica gel were peptide fission, deamination, and diketopiperazine formation. Decarboxylation was negligible since no other ninhydrin-positive spots were detected on either irradiation. (BBB)

51426 FORMATION OF INTERMEDIATES IN THE REPLICATION OF PHAGE LAMBDA DNA. **Salzman, Lois A.; Weissbach, Arthur (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). J. Mol. Biol., 28: 53-70(Aug. 28, 1967).**

Radiobiology experiments revealed evidence for the formation of two new species of λ DNA that account for a large part of the DNA synthesized after induction of Escherichia coli K12(λ) by uv light. Ultraviolet-induced cells were pulse labeled with ^{3}H-thymidine at various times after induction, commencing at 45 min, when rapid DNA synthesis was about to start. At 45 min after uv induction the pulse-labeled DNA appeared to sediment in 2 broad peaks. The bulk of the DNA migrated at the same rate or slightly faster than the mature linear, λ DNA marker. Much of the newly synthesized DNA was present as intermediate forms that were clearly distinguishable from mature λ DNA. One of the new DNA species was very sensitive to shearing and showed a relatively high sedimentation rate when compared to normal λ DNA. Its properties were consistent with those of a long, linear, concatenated structure. The intermediate forms of λ DNA were apparently formed from smaller DNA molecules the size of mature λ DNA. In the latter part of the latent period just before cell lysis, these large intermediates were broken down to DNA of the size found in the normal phage particle. Mutants, λ_{susA} and λ_{susD} were found to accumulate large amounts of the intermediate during λ DNA synthesis and were unable to convert them to mature phage DNA. (BBB)

51427 HISTOCHEMICAL AND BIOCHEMICAL ASPECTS OF IODINE BINDING IN THE TUNIC OF THE ASCIDIAN, DENDRODOA GROSSULARIA (VAN BENEDEN). **Barrington, E. J. W.; Thorpe, A. (Univ. of Nottingham, Eng.). Proc. Roy. Soc., (London), Ser. B, 171: 91-109(Aug. 13, 1968).**

Radioiodine binding by the tunic of Dendrodoa was studied by histochemical procedures to reveal factors that might promote the binding by autoradiography to define the location of the radioiodine, and by radiochromatography to identify the products. Animals were immersed for 4 to 5 days at 10°C in sea water containing 500 μCi of ^{131}I/l. Autoradiography showed that bound ^{131}I was distributed throughout the tunic, down to the level of the mantle epithelium, but that it was especially concentrated in the surface cuticle, which is mainly formed from a concentration of the protein fibers. There was a tendency for radioiodine to become clumped around certain wandering cells and accumulations of granules in the tunic; this could be a result of adsorption, or it may indicate some metabolic activity at these points. The association was sporadic, however, and the ^{131}I was not exclusively associated with any particular type of cell. Its widespread distribution appeared to reflect the corresponding distribution of tyrosine-rich proteins in the tunic. By radiochromatography of tunic extracts, monoiodotyrosine and diiodotyrosine were readily identifiable. Unknown radioiodinated compounds were present, but thyroxine and triiodothyronine were not found. Thyroxine and triiodothyronine may be present in trace amounts, but the results as a whole do not indicate that iodine binding by the ascidian tunic is a form of thyroidal biosynthesis. It seems rather to resemble the iodination that occurs in the surface skeletal tissues of many invertebrates. (BBB)

51428 EFFECT OF AN X-RAY DOSE ON PYROPHOSPHATASE ACTIVITY IN MOUSE BRAIN. **Stefan, M.; Ghizari, E. Fiziol. Norm. Patol. (Bucharest), 13: 361-3(1967). (In Rumanian).**

The activity of pyrophosphatase was measured in the brain of mice irradiated with 12.5 to 500 R x rays. Changes in the activity of this enzyme in the animals irradiated with 500 and 250 R were noted half an hour after irradiation. Following irradiation with 12.5 to 125 R, the alterations were only noted after 24 hours. (Rom. Sci. Abstr.)

51429 MULTIPLICATION OF FOOT-AND-MOUTH DISEASE VIRUS IN IRRADIATED ADULT RODENTS. **Mayo, J. (Comision Nacional de Energia Atomica, Buenos Aires); Lombardo, J. H.; Smolko, E. E.; Segura, M.; Rivenson, S. Rev. Invest. Agropecuar., Ser. 4, 3: No. 6, 58-69(1966). (In Spanish).**

Adult rats and hamsters, naturally immune to foot-and-mouth disease virus, showed viral multiplication when submitted to whole-body x irradiation of the order of LD50 and LD100/30. Tests showed that the viral multiplication was particularly intensive. Proliferation of the virus in different organs was observed (heart, muscle, brain, and liver). There were differences of susceptibility according to the species, and higher proliferation when the exposure was increased. (TSS)

51430 COMPARATIVE ASSESSMENT OF VARIOUS METHODS USED FOR DETECTION OF AUTOANTIBODIES. **Klemparskaya, N. N. Zh. Mikrobiol., Epidemiol. Immunobiol., No. 6, 135-42 (June 1968). (In Russian).**

Dynamics of autoimmune reaction development was studied with the aid of Hoigner reaction with autoerythrocyte lysate, complement fixation, passive hemagglutination, leukocyte lysis reactions, and by calculation of the leukocyte injury index in rabbits subjected to homosensitization alone or to homosensitization in conjunction with skin transplantation and x irradiation at a nonlethal dose (600 R). Hoigner reaction with the hemolysate proved to be the most sensitive. (auth)

51431 INDUCTION OF TOLERANCE FOR TRANSPLANTATION IN ADULT MICE OF DIFFERENT H_2 LOCI. **Liacopoulous, P.; Herlem, G.; Perramant, M. F. (Hopital Broussais, Paris). Ann. Inst. Pasteur, 113: 618(Oct. 1967). (In French).**

Adult mice A/J(H_2a), irradiated with 700 R and transfused with spleen cells from CBA (H_2k) donors, developed homologous disease that was fatal to 80% of recipients. Treatment of donors with high doses of rabbit γ-globulin, before harvesting their spleen cells, resulted in an inhibition of the homologous disease in the recipients (fatal to only 20%). Nearly all the surviving A/J mice that received 25×10^6 or more spleen cells developed tolerance and accepted permanently (for more than 1 yr) grafts of skin from the donor strain mice. This tolerance was due to the establishment of chimeric state. Cytologic studies showed that in mice tolerant for more than six months about 80 to 90% of the lymph cells as well as the red cells were of the donor type. (BBB)

51432 AMYLOIDOSIS INDUCED BY CELL TRANSFER: EFFECTS OF HEAT-DAMAGED AND OF X-IRRADIATED SPLEEN CELLS FROM CASEIN-SENSITIZED MICE. **Werdelin, Ole (Univ. Inst. of Pathological Anatomy, Copenhagen). Acta Pathol. Microbiol. Scand., 72: 23-30(1968).**

The amyloidosis-enhancing effect of transplantation of spleen cells from casein-sensitized mice to syngeneic recipients was compared with that of x-ray-killed and heat-damaged cells from the same group of donors. The amyloidosis-promoting effect of transplantation of spleen cells from mice with casein amyloidosis to syngeneic recipients was not abolished by damage to the cells brought about by heating or 1000- or 2000-R x irradiation prior to transplantation. The recipients were treated with a mitosis-inhibiting drug immediately after the cell transfer. This may have concealed any difference between amyloidosis-enhancing effects of damaged cells and undamaged cells dependent upon proliferative capability. In a 2nd experiment, a period of casein treatment was interposed after the cell transfer before proliferation was stopped by nitrogen mustard treatment. X irradiation of the spleen cells prior to the cell transfer did not weaken their amyloidosis-promoting effect. It was concluded that the amyloidosis-enhancing effect of syngeneic transplantation of spleen cells from casein-sensitized mice is not dependent on heat-labile metabolic activi-

ties in the transplanted cells or their capability to proliferate. (BBB)

51433 TRANSFER OF TOLERANCE TO HOMOGRAFTS BY THE THYMUS OF TOLERANT MICE: GRAFTING IN THYMECTOMIZED MICE. Toullet, F. (Hopital Saint-Antoine, Paris); Waksman, B. H. Ann. Inst. Pasteur, 113: 618-19(Oct. 1967). (In French).

It was found possible to induce tolerance to a protein antigen in rats thymectomized and irradiated as adults by grafting them with the thymus of rats tolerant to that protein. Tolerance to homografts could be similarly transmitted to the thymectomized mice at birth by grafting the thymus of a tolerant animal. Strain A mice thymectomized at birth, that received at the age of three weeks a thymus from mice of the same age, were able to reject skin grafts from CBA and $C_{57}BL/KS$ mice. If the thymus, either intact or in fragments, came from an A mouse made tolerant of the skin of a CBA mouse by the injection of CBA spleen cells at birth; the thymectomized recipients acquired the capacity to reject the skin of $C_{57}BL/KS$ mice, but failed to reject the CBA mouse skin. The percentage of CBA cells present in the thymus of the A mice tolerant of CBA skin was established by using mice of strain CBAT6T6, co-isogenic of CBA, that possessed a double chromosome marker. This percentage (11 to 23%) was too small to explain the transfer of tolerance by the presence of CBA cells in the tolerant A thymus. The tolerant A thymus cells were thus responsible for the establishment of tolerance to the graft of CBA skin in the thymectomized recipients. (BBB)

51434 DETERMINATION OF THE CONTENT OF IODINE IN SERUM AND THYROGLOBULIN. Wenzel, K. W.; Rotzsch, W. (Karl-Marx-Univ., Leipzig). Rev. Roum. Biochim., 5: 39-48 (1968). (In French).

A method of I determination is given for I organically bound in two zones of determination. After the organic material was incinerated with chloric acid, I was determined by the action of I ions on the reduction of Ce(IV) by arsenious acid. This catalytic action was stopped by the addition of brucine. The color formed was measured at a maximum at 460 nm. In the region around 0.025 μg I, 2.5 μg I could be determined with a precision of at least 1%. A determination on serum samples showed a mean level and a standard deviation of 5.48 ± 1.41 μg% for total I and 5.11 ± 1.41 μg% for protein-bound I. Thyroglobulin prepared from swine thyroids was found to have an I content of 0.64%. The effect of incubation temperatures on the catalytic action of I and on the standard curve was discussed. The method offered considerable improvement over the errors quoted for bound I in the literature; because of its sensitivity, special precautions to avoid contamination of glassware were suggested. (BBB)

51435 INHIBITION OF DARK REPAIR OF ULTRAVIOLET DAMAGE IN DNA BY CAFFEINE AND 8-CHLOROCAFFEINE. KINETICS OF INHIBITION. Lumb, Judith Rae; Sideropoulos, Aris S.; Shankel, Delbert M. (Univ. of Kansas, Lawrence). Mol. Gen. Genet., 102: 108-11(Aug. 5, 1968).

The inhibition of dark repair by caffeine and 8-chlorocaffeine was investigated by a cellular enzyme kinetics system. The results suggested that the caffeine and 8-chlorocaffeine acted by inhibiting the excision enzyme of the dark repair system. (auth)

51436 DIMER PHOTOPRODUCTS IN CYTIDYLYL-(3'-5') CYTIDINE. Hariharan, P. V.; Johns, H. E. (Toronto Univ.). Photochem. Photobiol., 8: 11-22(July 1968).

When CpC is exposed to ultraviolet radiation, dimers are produced both photochemically and by dark reactions. A reaction scheme for the production of these dimers is presented. It is shown that a single dimer, CpC_1, is initially produced photochemically. This is converted by a spontaneous reaction to a second dimer, CpC_2. The dimer CpC_2 may also spontaneously revert back to CpC_1 and if no side reactions were involved a thermal equilibrium between these two dimers would be established with about two to three times the concentration of CpC_2 as of CpC_1. The rate constants for the interconversion of these two dimers vary from about 0.05 to 0.4 hr^{-1} over the pH range 2.7 to 8.4. The dimers of CpC have maximum stability near pH 7. The two dimers CpC_1 and CpC_2 can also be reversed to CpC by u.v. irradiation. Both these dimers in turn deaminate to dimers of UpC and then to UpU. The rate constants for these deamination reactions are presented. These lie in the range 0.01 to 0.5 hr^{-1} for the pH values studied. Possible structures for the two dimers are suggested. (auth)

51437 STUDIES ON THE LEUKOCYTOSIS-PROMOTING ACTIVITY OF SALIVA PAROTIN A. Shinoda, Masato; Takagi, Yoshinari; Tamaoki, Bun-ichi (National Inst. of Radiological Sciences, Chiba, Japan). Yakugaku Zasshi, 86: 906-10(Oct. 1966). (In Japanese).

The mechanism of action of the leukocytosis-promoting activity of saliva parotin-A was examined in normal and x-irradiated rabbits (400 or 600 R). This activity of saliva parotin-A was chiefly carried by granulocytes and was manifested by a drop in lymphocytes and monocytes. The serum from rabbits two and six hours after the administration of saliva parotin-A had a strong leukocytosis-promoting activity originating in the granulocytes. Since immunochemical measurements revealed that this reaction was not due to the originally administered saliva parotin-A, it was suggested that a leukocytosis-promoting factor was produced secondarily in vivo by the administration of saliva parotin-A, and this factor appears in the serum. This factor was observed similarly in both x-irradiated and control rabbits, although its level was lower in the serum of irradiated rabbits. (BBB)

51438 RADIOISOTOPE METHODS OF EXAMINATION OF BODY FLUIDS. III. DETERMINATION OF THE TOTAL EXCHANGEABLE SODIUM AND POTASSIUM BY ^{24}Na AND ^{42}K. Kapitola, J. (Univ., Karlovy, Prague). Sb. Lek., 70: 121-8 (1968). (In Czech).

Exchangeable body Na could be determined 24 hr following oral administration of ^{24}Na, while exchangeable K could be determined 24 hr following intravenous ^{42}K administration. Oral administration of ^{42}K was followed by rise of the values of exchangeable K after 24 to 48 hr indicating that the steady state was not reached after 24 hr. It is advisable, in clinical practice, to determine exchangeable Na in a sample of plasma 24 hr following oral administration and exchangeable K in a sample of urine 24 hr following intravenous radioisotope administration. The mean result obtained in 31 subjects was 36.8 meq/Kg body weight for Na, and the mean result of 66 normal values for K was 40.3 meq/Kg body weight. Division of the values of exchangeable K into 3 age groups for each sex showed the age dependence which must be taken into account in evaluating the results. Exchangeable K is higher in men than in women and higher in younger persons than older. The methods described are suitable especially for follow-up of changes in repeated examinations in the same patient. Methodological deviations can lead to considerable differences in the final results. The methods should therefore be standardized so that results obtained in different laboratories are comparable. (BBB)

51439 SERUM CALCIUM HOMEOSTASIS IN RADIOIODINE-TREATED THYROTOXIC SUBJECTS AS MEASURED BY ETHYLENEDIAMINETETRAACETATE INFUSION. Goldsmith, R. E.; King, L. R.; Zalme, E.; Bahr, G. K. (Univ. of Cincinnati). Acta Endocrinol., 58: 565-77(Aug. 1968).

Seventy-four subjects treated for thyrotoxicosis with radioiodine (^{131}I) were studied by ethylenediaminetetraacetate (EDTA) infusion. Thyroidectomized euthyroid goiter patients demonstrate abnormal EDTA responsiveness when compared to normal subjects and to goitrous but unoperated subject. The ^{131}I dose was <10 mCi in 29 and 10 mCi or larger in 45 subjects. The response of the ^{131}I-treated patients to a standard hypocalcemic test with EDTA was followed by serum Ca and inorganic P analyses. The ^{131}I-treated subjects were separated into euthyroid, hypothyroid, and hypothyroid-treated-with-replacement-thyroid-medication groups. These groups were compared to a fourth group of 29 normal subjects. The results suggested that impairment of Ca mobilization was present in the ^{131}I-irradiated subjects. However, most of the impairment could be correlated with the presence of hypothyroidism, and no loss of parathyroid reserve was evident. (BBB)

51440 BIOLOGICAL EFFECTS OF RADIATION. CERN Cour., 8: 209-11(Sept. 1968).

A review of the effects of ionizing radiation on living matter is presented. Relative sensitivity of parts of the cell is discussed. The effects of increasing doses of radiation result successively in slight disturbance to the metabolism of the cell, abnormal cell reproduction, inhibition of cell division, and destruction of the cell. A diagram is presented to show relation of time following radiation exposure to molecular changes, physiological effects, biochemical lesions, mutations, visible lesions, cell death, and death of the organism. Biological and medical research using high energy particles generated by accelerators is discussed. (H.L.W.)

51441 ULTRAVIOLET-INDUCED PYRIMIDINE DIMERS IN TETRAHYMENA. I. REMOVAL IN THE DARK. Whitson, G. L.; Francis, A. A.; Carrier, W. L. (Oak Ridge National Lab., Tenn.). Biochim. Biophys. Acta, 161: 285-90(July 23, 1968).

Thymine-containing pyrimidine dimers were isolated and identified chromatographically from DNA hydrolysates of ultraviolet-irradiated Tetrahymena. Removal of these photoproducts was observed during post-irradiation growth of cells in the dark. After 47 h, about 83% of the pyrimidine dimers disappear from the trichloroacetic acid-insoluble fraction. Further analysis of both the trichloroacetic acid-insoluble and trichloroacetic acid-soluble fractions indicated that photoproducts accumulating in the soluble

fraction are eventually lost from the cytoplasm of irradiated cells. (auth)

51442 TRANSFER RNA. II. A STRUCTURAL BASIS FOR ALANINE ACCEPTOR ACTIVITY. Schulman, LaDonne H.; Chambers, Robert Warner (New York Univ. School of Medicine). Proc. Nat. Acad. Sci. U. S., 61: 308-15(Sept. 15, 1968).

Experiments described led to the following conclusions: $tRNA^{ala\ lab}$ undergoes extensive photochemical modification without loss of its acceptor activity; $tRNA^{ala\ lab}$ is inactivated by formation of a single photoproduct located in the stem nucleotides near the acceptor end of the molecule; localized ordered structure is necessary for acceptor activity, but a unique conformation of the entire molecule is not necessary. Based on UV-inactivation studies and the structural data in the literature for various tRNA's, it was suggested that the specific recognition site for the aminoacyl-tRNA synthetase involved the first three pairs of tRNA. However, the ordered structure of the entire stem region near the acceptor end, and possibly other portions of the molecule, may be necessary for the correct stereochemical alignment of the recognition nucleotides. (auth)

51443 TRANSFORMATION IN MICROCOCCUS RADIODURANS AND THE ULTRAVIOLET SENSITIVITY OF ITS TRANSFORMING DNA. Moseley, B. E. B.; Setlow, Jane K. (Oak Ridge National Lab., Tenn.). Proc. Nat. Acad. Sci. U. S., 61: 176-83(Sept. 15, 1968).

Evidence was presented that Micrococcus radiodurans could undergo transformation. The frequency of transformation was increased about 100-fold in the presence of a heat-stable factor from a crude extract of wild-type M. radiodurans. This extract also increased the frequency of transformation in Haemophilus influenzae of low competence. The extract decreased DNA uptake in M. radiodurans because of competition by DNA in the crude extract. Transforming activity in DNA from M. radiodurans appeared to be UV-resistant and was not increased by treatment with yeast photoreactivating enzyme. It was concluded that the recipient cells efficiently repaired pyrimidine dimer damage in transforming DNA as they did in cellular DNA when cells themselves were irradiated. (auth)

51444 UPTAKE OF SODIUM FLUORENE-2-SELENONATE-^{75}Se BY SPLEEN AND OF SODIUM N-7-FLUORENYLACETAMIDO-2-SELENONATE-^{75}Se BY TUMOR IN MICE. Agrawal, Krishna C.; Ray, F. E. (Univ. of Florida, Gainesville). Int. J. Cancer, 2: 257-64(May 15, 1967).

Two new radioactive compounds, sodium fluorene-2-selenonate-^{75}Se, (II), and sodium N-7-fluorenylacetamido-2-selenonate-^{75}Se, (V), have been synthesized. The tissue distribution of these compounds in tumor-bearing mice has been studied at different time intervals. The first compound localized itself in spleen, and its distribution was also studied in tumor-free mice. This compound gave quite favorable ratios of concentration in spleen to the concentration in tissues. The use of this compound in splenic scanning is suggested. The second compound was concentrated in tumor to a greater extent than in the vital organs, from which it was eliminated later, showing the affinity of the compound for the tumor tissue. (auth)

51445 ISPOL'ZOBANIE IZOTOPOV I IZLUCHENII V ISSLEDOVANIYAKH PO SEL'SKOMU KHOZYAISTVU. MATERIALY NAUCHNO-METOBICHESKOGO SOVESHCHANUYA STRANCHLENOV SEB, SOSTOYABCHEGOSYA V 1965. (Use of Isotopes and Irradiation in Studies in Agriculture, 1965. Proceedings of a Scientific Research Conference of the Members of the Council on Mutual Assistance in Agriculture). Nerpina, S. B. (ed.). Moscow, Izlatel'stvo Kolos, 1967. 264p. (NP-17449).

Forty-two papers on the uses of radiation and radioisotopes in agriculture are included. Some topics discussed are: absorption of uranium and plutonium fission products by plants; assimilation of nitrogen from mineral fertilizers by plants; radioinduced chromosome aberrations; metabolism of labeled nitrogen in ripening grains of wheat; ^{14}C studies on photosynthesis; use of ionizing radiation in the selection of plants and microorganisms; use of tracer techniques for studies on migration and dispersion of insects in Czechoslovakia; uptake of radiostrontium by plants; metabolism of pesticides in the animal organism; x radiation effects on chickens; distribution of ^{90}Sr and ^{137}Cs in the animal body; and the use of radioisotopes in studies on the ecology of rodents. (H.L.W.)

51446 LUMINESCENCE OF L-TRYPTOPHAN IN THE DRY STATE AND IN AQUEOUS SOLUTION INDUCED BY X-RAYS AND U.V.-LIGHT AT 77°K. Steen, H. B. (Norsk Hydro's Inst. for Cancer Research, Oslo). Photochem. Photobiol., 8: 47-51(July 1968).

The luminescence from tryptophan in the dry state and in aqueous glass, induced by uv light and x rays at 77°K, has been studied. The spectra of the luminescence from the dry material, which were identical for the two types of irradiation, were attributed to the same excited singlet level as that giving rise to the fluorescence from the aqueous sample. The strong phosphorescence exhibited by the latter, could not be detected for the dry material with either type of irradiation. This was attributed to a strong quenching of the radiative triplet level occurring upon crystallization of the substance. The yield of x-ray induced fluorescence of tryptophan in aqueous glass was found to be similar to that observed in the dry state. It was concluded that there is no extensive transfer of energy between the solvent and the solute molecules contributing to the fluorescence yield of tryptophan in aqueous glass. (auth)

51447 PHOTOPRODUCT FORMATION IN DNA AT LOW TEMPERATURES. Rahn, R. O.; Hosszu, J. L. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Photochem. Photobiol., 8: 53-63(July 1968). (ORNL-P-3470).

The temperature dependence of thymine photoproduct formation in Escherichia coli DNA dissolved either in water or in a 50 per cent ethylene glycol solution was studied at temperatures between +25 and −196°C. At low temperatures, the formation of thymine dimer was strongly inhibited. A dose of 1×10^4 ergs/mm^2 at 280 nm converted 2 per cent of the thymine to dimer at 25°C as compared with 0.2 per cent at −196°C. In addition, a new thymine photoproduct which was both nonphotoreversible and nonphotoreactivable was found at low temperatures. On the basis of its chromatographic mobility, this new photoproduct was assumed to be the same as that isolated from irradiated spores of Bacillus megaterium. Extensive irradiation at 254 nm of DNA at −120°C resulted in a yield of >23 per cent for the 'spore-type' photoproduct as compared with 6 per cent for the thymine dimer. In poly d(AT), irradiated at low temperature, no spore-type photoproduct was found; this suggests that adjacent thymine residues are necessary for the formation of the spore-type photoproduct. (auth)

51448 THE INTESTINAL ABSORPTION OF ^{47}Ca BY PATIENTS IN CHRONIC RENAL FAILURE. Ogg, C. S. (Guy's Hospital, London). Clin. Sci., 34: 467-71(June 1968).

Intestinal absorption of ^{47}Ca was measured in 11 normal subjects, 14 patients with chronic renal failure without evidence of bone disease, and 9 patients with renal glomerular osteodystrophy. Doses of 15 μCi of ^{47}Ca were given orally with 100 mg of stable Ca as $CaCl_2$. The absorption of the isotope was assessed either by measurement of the percentage recovery of the dose in the feces or by the ^{47}Sc inert marker technique. Patients with renal failure absorbed a significantly lower proportion of the ^{47}Ca than normal controls. There was no difference in the mean absorption of ^{47}Ca by patients with renal failure with and without overt bone disease. Since development of renal glomerular osteodystrophy does not result in any change in the intestinal absorption of Ca by subjects in renal failure, progression of the skeletal manifestations of chronic renal failure is likely to be due to the redistribution of Ca within the body. (BBB)

51449 CONCENTRATIONS OF ZINC AND COPPER IN THE TISSUES OF DECAPOD CRUSTACEANS. Bryan, G. W. (Plymouth Lab., Eng.). J. Mar. Biol. Ass. U. K., 48: 303-21(June 1968).

Concentrations of Zn and Cu and uptake of ^{65}Zn were measured in 18 species of decapod crustaceans, ranging from freshwater to purely marine species. Although the intake of Zn and Cu probably varies considerably, most animals contain between 20 and 35 μg/g of both metals. Reasons for differences between the concentrations of Zn and Cu in the individual tissues of different species are discussed and the ways in which regulation is achieved are compared. Concentration factors relating the concentration of Zn in the animal to that in the water are almost inversely proportional. In the event of the water being contaminated with ^{65}Zn, equilibrium concentration factors for the nuclide will decrease as the amount of Zn in the water increases. (TSS)

51450 STUDY OF SOME PHYSICAL CHEMICAL PARAMETERS OF THE DNA OBTAINED FROM LIVER OF IRRADIATED RATS. Marinescu, C.; Popa, R.; Florescu, I. Rev. Sanit. Mil., 63: 879-83(Nov.-Dec. 1967). (In Rumanian).

Studies of 4 groups of 30 rats, each irradiated with 400, 500, 700 or 800 R investigated survival times, molecular weight of the hepatic DNA and mean values of the molecular diameter, and concentration of DNA in the liver. Relatively straight dose-response curve was noted. (JPRS)

51451 ^{131}I CONVERSION RATIO IN DOMESTIC BIRDS. Mellen, W. J. (Univ. of Massachusetts, Amherst). Gen. Comp. Endocrinol., 10: 315-29(1968).

The ^{131}I conversion ratio (CR) in chickens at 24, 48, 72, and 96

hr following injection of ^{131}I was increased by thyrotropin administration. In radiothyroidectomized chickens and in birds with hereditary hypothyrodism, 24- and 48-hr CR's were below normal; but 72- and 96-hr values were normal or above normal. A possible explanation for this seemingly anomalous situation is presented. Experiments with chickens and turkeys showed the following to be important sources of variation in CR: genotype (species, strain), sex, age, time elapsed between ^{131}I injection and drawing of blood, and interactions among these factors. In chickens, significant strain differences in CR agreed well with other indicators of thyroid state. The CR in Japanese quail is lower than that in chickens. In Pekin ducklings the CR reaches a maximum at least as high as that in the chicken. The avian CR appears usually to reach a plateau by 48 to 72 hr following ^{131}I injection, instead of continually rising, as might be expected from theoretical considerations. In chickens, the maximum mean value is usually no greater than 75 to 80%, and in many cases lower. (BBB)

51452 SUPPRESSION OF HEMOPOIETIC COLONY-FORMING UNITS IN MICE BY GRAFT-VERSUS-HOST REACTIONS. **Davis, William E. Jr.; Cole, Leonard J. (Naval Radiological Defense Lab., San Francisco). Transplantation, 5: 60-7(Jan. 1967).**

Male (C57L X A/He) F_1 hybrid mice (so-called LAF_1) and the parental strain, A/He males were used to characterize the time course of parental-vs-F_1 hybrid immunological reactions in sublethally irradiated animals. It was possible to reverse the lethal effect of the reaction by means of a second dose of x rays delivered up to four days after injection of the parental lymphoid cells. In contrast, mice irradiated five days or later succumbed to the disease. Nonirradiated host-type colony-forming units in the spleens of mice undergoing the parental-F_1 hybrid disease were depleted at five days, and in the marrow by seven days. It was not possible to reverse the lethal course of the disease with large doses of host type hemopoietic cells injected three to six days after injection of the parental cells. (BBB)

51453 IN VITRO AUTORADIOGRAPHIC STUDIES OF CELL PROLIFERATION IN THE GASTROINTESTINAL TRACT OF MAN. Galand, P.; Mainguet, P.; Arguello, M.; Chretien, J.; Douxfils, N. (Free Univ., Brussels). J. Nucl. Med., 9: 37-9(Jan. 1968).

The S phase (phase of desoxyribonucleic acid synthesis) and cell cycle duration was measured in human rectal mucosal epithelium incubated in vitro with ^3H-thymidine. The results obtained on autoradiograms was quite reproducible and seems compatible with the available data in the literature concerning estimates made after in vivo labeling of this tissue. Therefore the procedure seems to constitute a way of avoiding the biological hazards of using ^3H-thymidine when studying the proliferation of human tissues. (auth)

51454 GLOBULIN COATING IN VIVO OF EHRLICH'S ASCITES CARCINOMA CELLS. Thunold, Svein (Gade Inst., Bergen). Transplantation, 6: 716-27(Aug. 1968).

Ehrlich ascites carcinoma transplants in normal and irradiated C3H mice were examined for the presence of γ-globulin on their surface. Results obtained by the mixed agglutination test and the antiglobulin consumption test showed γ-globulin attached to the surface of tumor cells from immunologically competent hosts. The amount of γ-globulin bound to cells from irradiated mice was significantly reduced. Judged by the indirect fluorescence reaction circulating antibody against the tumor cells appeared in the serum after tumor rejection, while it was absent in serum from mice carrying a tumor. Antibody against red cells or leucocytes was not detected in either of these sera. These findings strongly suggested in vivo absorption of antibody by the tumor graft. This antibody might be directed against transplantation tissue antigens as well as tumor specific components on the tumor cell surface. (auth)

51455 INACTIVATION, INDUCED BY GAMMA RADIATION, OF PAPAIN IN HYDROALCOHOLIC SOLUTION. Di Marco, Giorgio (Univ., Rome. CNR, Rome). Ric. Sci., 38: 377-81 (Apr. 1968). (In Italian).

Papain was irradiated in 70% ethyl alcohol and in aqueous solution by means of γ rays. Initial G of inactivation in 70% ethyl alcohol reached about half values at the initial in aqueous solution. The O_2 effect was present in both cases, but was less evident in hydroalcoholic solution. Some theoretical considerations are presented. (auth)

51456 AN EVALUATION OF THE IRRADIATED HAMSTER TEST AS A MEANS OF PREDICTING HISTOCOMPATIBILITY IN VARIOUS SPECIES. Streilein, J. W.; Billingham, R. E. (Univ. of Pennsylvania, Philadelphia). Transplantation, 6: 694-705(Aug. 1968).

Critical experiments were carried out, employing genetically defined though heterogeneous populations of hamsters, rats, and mice as cell donors to evaluate the capacity of the irradiated hamster to furnish a test system capable of assessing degrees of histoincompatibility as measured by the survival times of skin homografts. The experiments were designed to insure that only one-way reactions could take place in the mixed cell populations under test. Major incompatibility, as evidenced by rapid skin homograft rejections, was indicated by significantly positive skin reactions (>1+) in 85% of tests. Although lesser degrees of histoincompatibility were often detectable, they were not represented by positive hamster skin test reactions frequently enough to allow reliable predictions of homograft survival times to be made. It is concluded that, as a donor-matching procedure, the test can provide useful information concerning the existence or absence of high degrees of histoincompatibility. (TSS)

51457 VIRUS AND DNA SYNTHESIS IN X-IRRADIATED HUMAN KIDNEY CELL CULTURES EXPOSED TO ADENOVIRUS TYPE 12. Harnois, Marion; Ho, Monto (Univ. of Pittsburgh). Proc. Soc. Exp. Biol. Med., 128: 651-4(July 1968).

Synthesis of DNA in human kidney cell cultures was prevented by x irradiation. Adenovirus type 12 replicated in irradiated cells as well as unirradiated cells. Virus production was preceded and accompanied by marked increase in cells showing DNA synthesis in the nucleus as demonstrated by autoradiography, which may be virus and/or virus-stimulated cell DNA. (auth)

51458 TOXICITY OF TRITIUM-LABELED NUCLEOSIDES OTHER THAN THYMIDINE AND OF TRITIUM-LABELED AMINO ACIDS. **pp 338-41 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.**

Tritium-labeled leucine, proline, and histidine were less toxic in Escherichia coli than ^3H-nucleosides and led to a killing efficiency of approximately one-half the value obtained for ^3H-uridine and ^3H-thymidine. Studies on relative toxicity of ^3H-cytidine and ^3H-thymidine in HeLa cells in culture showed that up to 0.1 μCi of ^3H-cytidine per milliliter of medium had no significant effect on viability, while the same dose of ^3H-thymidine depressed survival to 19.8%. Studies on survival kinetics of Chinese hamster cells showed that more ^3H-uridine was tolerated by the cells than ^3H-thymidine when both precursors were allowed to be incorporated by all cells of the culture. Studies on human leukocytes in culture resulted in twice as many chromosome breaks following treatment with ^3H-uridine as that following treatment with ^3H-thymidine. (H.L.W.)

51459 TOXICITY OF TRITIUM-LABELED WATER. **pp 317-20 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.**

The dose of tritium required to produce toxic effects in Paramecium was very large compared with that for mammals. The predominant role of the nucleus in radiosensitivity of mammalian cells was shown by experiments on relative toxicity of tritium-labeled water and thymidine incorporated into DNA of HeLa tissue culture cells. Differential effects of radiation from tritium on nucleus and cytoplasm were evaluated with tritium-labeled water in experiments on chick embryo cells infected with rickettsiae. Results indicated an increase of metabolism in the nuclei with concomitant metabolic depression in the cytoplasm. Studies on bacteria from the bovine rumen exposed to tritium-labeled water showed that there was a stimulating effect on cell division and production of volatile fatty acids. When oxygen was present during the irradiation, a reduction in the number of viable cells subsequently occurred. Experiments on the effects of tritium-labeled water on mice resulted in 50% lethality within 30 days. (H.L.W.)

51460 RADIATION DECOMPOSITION OF TRITIUM-LABELED COMPOUNDS. **pp 56-71 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.**

The principal characteristics of tritium-labeled organic molecules are surveyed with emphasis on the stability of the label in biological systems and enzyme reactions. Among the labeled compounds discussed are; thymidine, amino acids, steroids, and compounds of extremely high specific activity. Methods for the determination of radiochemical purity of the specific compounds and a discussion of the radiation decomposition of tritium-labeled molecules and the storage conditions that should be observed for them are also included. (E.R.B.)

51461 BIOLOGICAL STABILITY OF THE LABEL. **pp 48-56 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.**

Biological stability of the tritium label in the metabolism of nucleic acids and their precursors, uridine, cytidine, thymidine, adenine, and guanine is discussed. The significance of the position of tritium in purine rings and pyrimidine bases is pointed out.

Studies on metabolism of amino acids showed that tritium in aromatic rings of tyrosine and dioxyphenylalanine was relatively labile. However, double labeling checks with ^{14}C during the conversion of dioxyphenylalanine to catechol amines of the adrenals indicated the biological stability of the tritium on the aromatic ring in this amino acid. It is pointed out that hydrogen exchange rates in proteins are important for studies on protein structure. In the course of carbohydrate metabolism, the tritium-hydrogen exchange helps to identify enzymatic reaction mechanisms. The rapid turnover of carbohydrates in a living system limits tritium stability in these molecules. In studies on lipids, double-labeled molecules were used to verify the biological half-life of cholesterol injected into animals. With both labels identical slopes were obtained that indicated the stability and true tracer behavior of tribium-labeled cholesterol. (H.L.W.)

51462 LABELING OF ORGANIC MOLECULES WITH TRITIUM. pp 26-48 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The labeling of organic molecules with tritium can be readily achieved if the proper technique is employed. The principles involved and the methodology are discussed for the following techniques; recoil labeling, gas exposure, conventional chemical means, and biosynthesis. Examples of the use of each technique are also discussed. (E.R.B.)

51463 ISOTOPE EFFECTS. pp 16-26 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The substitution of tritium for hydrogen in biochemical reactions involving, directly or indirectly, hydrogen bonds, may well lead to primary or secondary isotope effects. This phenomenon occurs when the difference in mass of the radioisotope from that of the stable isotope is reflected in the reaction rate. Examples involving tritium-labeled water and tritium-labeled methyl groups are given. Methods for determining whether an isotope effect has occurred are discussed. (E.R.B.)

51464 TRITIUM-LABELED MOLECULES IN BIOLOGY AND MEDICINE. Feinendegen, Ludwig E. American Institute of Biological Sciences and U. S. Atomic Energy Commission Monograph Series on Radiation Biology. New York and London, Academic Press, 1967. 430p. $27.50. (TID-24138).

Separate abstracts were prepared on 17 sections of this book discussing the use of tritium-labeled compounds as tracers in biological and medical research. An introduction to the physics of tritium is included and general factors influencing the incorporation of exogenous precursors in intact organisms are discussed. Other topics included are the chemistry and production of tritium-labeled compounds, counting techniques, autoradiography, and the toxicity of tritium in living systems. (H.L.W.)

For abstracts of individual sections see: 51240, 51458–51463, 51553, 51555, 51661–51665, 51862, 52537, and 53091.

51465 DISTRIBUTION OF ^{89}Sr AND ^{45}Ca IN BONE, BRAIN, AND OTHER TISSUES OF THE RAT. Chow, S. Y.; Tou, J. H.; Woodbury, D. M. (National Defense Medical Center, Taipei, China). Chin. J. Physiol., 20: 1-11 (June 30, 1967).

The relative distribution of ^{89}Sr and ^{45}Ca in bone, brain, heart, liver, skeletal muscle, skin, and testis was studied in adult male rats. The concentrations of radioactive Sr and Ca in the tibia increased rapidly after intraperitoneal injection. At 24 hr after injection of radioisotopes, the tibia/plasma ratio was 118 for ^{89}Sr and 68 for ^{45}Ca. The uptakes of ^{89}Sr and ^{45}Ca by brain were fairly slow compared with other soft tissues. The concentrations of ^{89}Sr and ^{45}Ca in heart, liver, skin, skeletal muscle, and testis were roughly parallel to their concentrations in plasma. In heart, liver, brain, and skeletal muscle, the tissue/plasma ratios of ^{45}Ca were higher than those of ^{89}Sr in spite of the fact that the radioactivity of ^{45}Ca in plasma was lower than that of ^{89}Sr. In bone, skin, and testis, the tissue/plasma ratios of ^{89}Sr were higher than those of ^{45}Ca. At the end of 24 hr, 16% of injected ^{89}Sr and 4% of injected ^{45}Ca were excreted in the urine. (BBB)

51466 BINDING OF PLUTONIUM TO SERUM PROTEINS IN VITRO. Turner, G. A.; Taylor, D. M. (Inst. of Cancer Research, Belmont, Eng.). Radiat. Res., 36: 22-30(1968).

The interactions between tetravalent plutonium and horse serum proteins were studied in vitro by electrophoresis on cellulose acetate and by gel filtration. The results show that in horse serum, as in other mammalian sera, the plutonium is associated principally with the transferrin component of the β_1-globulins. The formation of the plutonium-transferrin complex requires the presence of HCO_3^-, and the plutonium is displaced from the complex by excess iron, thus indicating that similar binding sites may be involved in the complexing of iron and plutonium. The plutonium complex is considered to be less stable than the iron-transferrin complex, but plutonium can only be released from the transferrin complex by citrate or stronger chelating agents. (auth)

51467 ELECTRON PENETRATION IN HIGH-VOLTAGE MICROSCOPY. Cosslett, V. E. (Cambridge Univ., Eng.). Optik, 25: 383-8 (June 1967).

Discussion of the increase of usable specimen thickness with electron acceleration voltage is based either on the elastic mean free path of electrons, in amorphous material, or, in crystals, on the effective absorption coefficient. Maximum usable thickness of specimen was defined as that thickness through which a just visible image can be formed at a magnification just large enough to show all the resolved detail. The effect of increase in operating voltage is a slow rise in this limiting thickness, coupled with a rapid improvement in resolution because of reduced chromatic aberration. On the other hand, if maximum specimen thickness is defined as that which gives a predetermined amount of chromatic aberration, then this thickness increases approximately in proportion to the relativistically corrected voltage. An upper limit is again set by image visibility, and it can only be further increased by raising the incident illumination to the maximum which a given specimen can tolerate. It was concluded that the chief value of using operating voltages higher than 1 MV for electron microscopy is to give improved resolution, without appreciably increasing the usable thickness of specimen. (BBB)

51468 ISOLATION AND DETERMINATION OF ^{239}Pu IN THE URINE: BY A COLUMN OF POLI-TRIFLUORO-CHLOROETHYL-ENE SUPPORTING TRI-N-OCTYLAMINE. Testa, C. (CNEN, Rome). G. Fis. Sanit. Prot. Radiaz., 10: 202-8 (July-Sept. 1966). (In Italian). (RT/PROT-(67)3).

A new method is described for the determination of ^{239}Pu in the urine by isolating Pu(IV) on a column of poli-trifluoro-chloroethylene (Kel-F) impregnated of tri-n-octylamine (TNOA). One liter of urine is wet mineralized by boiling with HNO_3 and $HClO_4$; then plutonium is coprecipitated with calcium phosphate with a recovery greater than 95%. The precipitate is dissolved in 50 ml of 2 M HNO_3 and all plutonium is brought to Pu(IV); then the solution is passed through the Kel-F-TNOA column that holds selectively plutonium; after washing with 1 M HNO_3 to completely eliminate thorium and uranium, plutonium is eluted with a H_2SO_3 solution by reduction to Pu(III). Plutonium is then electroplated on a small stainless-steel disc from a $(NH_4)_2SO_4$ solution, and counted for 10 to 15 hours. The final recovery resulted greater than 90%; the decontamination factors from uranium, thorium, polonium and radium are greater than 150; among the transuranium elements, only neptunium(IV) could seriously interfere. (auth)

51469 EFFECTS OF X-IRRADIATION ON THE IMMUNE RESPONSE OF GUINEA PIGS TO Q FEVER VACCINE. Reynolds, Scott L.; Whitford, Howard W.; Blemly, Nelson R.; Staab, Edward V.; Craig, Charles P. (Army Medical Unit, Frederick, Md.). Radiat. Res., 36: 98-106(1968).

The immune response of guinea pigs to Q fever vaccine following 75 to 250 R (60 to 180 rads) of acute whole-body x irradiations was investigated. Complement-fixing (CF) antibody titers and protection against febrile response to challenge with virulent Coriella burnetii were studied. Exposures ranging from 75 to 250 R, 24 hours prior to inoculation, did not detectably alter the CF antibody response. Similar results were observed with 175 R delivered 48 to 72 hours before immunization. Protection against febrile response to challenge with 10^3 median fever doses of C. burnetii was seen in animals irradiated with 175 R, 24 or 72 hours before immunization. Significant protection was detectable at 14, 21, and 42 days after immunization in both irradiated and nonirradiated animals. Acute irradiation of the degree studied increases the mortality in normal animals infected 15 to 17 days later with virulent C. burnetii. The lethal effect could be prevented by use of Q fever vaccine. (auth)

51470 RADIATION CHEMISTRY OF THYMINE IN AQUEOUS SOLUTION. Loman, H.; Blok, Joh. (Vrije Univ., Amsterdam). Radiat. Res., 36: 1-13(1968).

The reactions of thymine in aqueous solution with γ or x radiation-induced radicals OH, H, and e^-_{aq} were studied under various conditions. Competition studies using scavengers of OH radicals (methanol, ethanol, iodide) or of e^-_{aq} and/or H atoms (N_2O, H^+, O_2) led to the conclusion that OH and H radicals destroy the chromophoric group of thymine, but e^-_{aq} does not. A trace of O_2 proved to be necessary to obtain maximal destruction. Removal of the last traces of O_2 resulted in a decrease of the destruction yield, possibly through restitution reactions. It was found that (1) alcohol radicals destroy thymine, even in the presence of O_2; (2) the rate

constant, k(OH + thymine) = 4.3×10^9 M^{-1} sec^{-1} (from competition with iodide); and (3) k(H + thymine) = 8×10^8 M^{-1} sec^{-1} (from competition with O_2 in acid solution). (auth)

51471 RADIATION-INDUCED GLYOXAL FORMATION IN SUGAR SOLUTIONS. Gotlieb, Itzhak; Markakis, Pericles (Michigan State Univ., East Lansing). Radiat. Res., 36: 55-8(1968).

Aqueous solutions (4%) of glucose, fructose, and sucrose were exposed to γ irradiation in the dose range of 2.2 to 24.0 megarads. The $G_{glyoxal}$ values at 2.2 megarads were 0.35, 0.18, and 0.06 for glucose, fructose, and sucrose, respectively. These values decreased at higher dose levels. The glyoxal concentration of the irradiated solutions did not appreciably change during a 2-week postirradiation storage at room temperature. (auth)

51472 ACTION OF GAMMA-RAY-IRRADIATED MEDIUM ON BACTERIA: RELATION TO THE ELECTRON TRANSPORT SYSTEM. Frey, H. E.; Pollard, E. C. (Pennsylvania State Univ., University Park). Radiat. Res., 36: 59-67(1968).

Gamma-ray-irradiated medium was found to produce an immediate slowing of respiration in cells of Escherichia coli 15 T^-L^-. It also introduced a lag in cell division that could be shortened by the presence of methylene blue and potassium cyanide. The lag was absent if the cells were grown anaerobically. These results suggest that the peroxides produced by irradiating medium block the electron transport system. Since cells concentrate peroxides, the loss of this function induced by bombardment was used to deduce the target molecular weight of the enzyme responsible. (auth)

51473 EFFECT OF IONIZING IRRADIATION ON THE LIPID BIOSYNTHESIS BY THYMUS AND LIVER. Miras, Constantinos J.; Mantzos, John D.; Legakis, Nicholas J.; Levis, Gabriel M. (Univ. of Athens). Contract AT(30-1)-3709. Radiat. Res., 36: 119-27 (1968).

New Zealand rabbits, fasted for 12 hours, were subjected to 500 rads of whole-body γ irradiation. Analysis of thymus lipids, at various time intervals following irradiation, showed a threefold increase of triglycerides at 24 hours. Fatty acid composition of the 600 × g supernatant was not affected at 24 hours after irradiation. Lipid biosynthesis from acetate-1-^{14}C by the thymus homogenates was increased to a small extent at 4 hours following irradiation, while the radioactivity distribution into fatty acids was not considerably affected. Contrary to the above findings, fatty acid synthesis from acetate-1-^{14}C by the liver preparations showed a decreased incorporation between the fourth and twelfth hour following irradiation. Counting of the radioactivity of the separated fatty acids suggested that the system for synthesis of short-chain fatty acids was impaired as early as 4 hours following irradiation. (auth)

51474 HEMATOLOGICAL RESPONSE TO ISOLOGOUS AND HOMOLOGOUS BONE MARROW TRANSPLANTATION: MECHANISM OF HOMOLOGOUS FAILURE. Kurnick, N. B.; Nokay, Naime (Univ. of California, Irvine. Long Beach Veterans Administration Hospital, Calif.). Radiat. Res., 36: 31-44(1968).

C_3H mice (H-2 locus = k, hemoglobin D) received marrow cells intravenously following supralethal total-body x-irradiation. Donors were C_3H, AKR (k, hemoglobin D), C57BR (k, hemoglobin S), A (a, hemoglobin D), and C57BL (b, hemoglobin S). Compatible marrow recipients suffered 20% mortality. Incompatible H-2 and hemoglobin donation resulted in 97% mortality by the twenty-fifth day. H-2-compatible, hemoglobin-incompatible recipients suffered 67% mortality by the fortieth day and then no further mortality. The H-2-incompatible, hemoglobin-compatible donation resulted in 36% mortality by the fortieth day and showed continued mortality thereafter. Peripheral blood hematocrit and granulocyte counts and bone marrow cellularity and DNAase activity revealed no significant differences, demonstrating successful grafts in all groups. However, the recovery of peripheral blood lymphocytes was inversely related to the mortality. Lymphopoiesis is apparently inhibited when the transplanted lymphocytes encounter overwhelming concentration of foreign antigens in the host. The H-2-compatible, hemoglobin-incompatible graft replaces the host's erythrocytes, thereby eliminating the inhibition of the graft's lymphocytic proliferation by that host antigen. During the first 40 days, homologous deaths result primarily from the effects of lymphopenia; thereafter, with recovery of lymphopoiesis, deaths are probably due to graft versus host reaction. (auth)

51475 THE RATE OF EXCRETION AND DISTRIBUTION OF ^{134}Cs, ^{85}Sr, AND ^{144}Ce CHLORIDES INTRAVENOUSLY ADMINISTERED TO RATS. Slouka, Vl. pp 238-43 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Experimental results obtained by studies of the rate of wash-out of intravenously administered chlorides ^{134}Cs, ^{85}Sr, and ^{144}Ce in rats are described. Eight hours after administration, less than 1% of the administered amount was noted in the blood. In the first phase a division of ca 88% of the intravenously applied amount of chlorides with hemodynamic half-time shorter than one minute occurred in the extracellular area. In the second phase which represents the uptake into the critical organs, ca 10% of applied amount circulates, in the third phase it amounts to 2%. The third phase corresponds to the redistribution in the organism and to the excretion by urine. In the second and third phases there are significant differences in time intervals depending on the distribution of radionuclide. After the administration of radioactive Ce in form of chelate with EDTA, no evidence of the third phase occurred; this fact serves as verification that no more significant transfers occur in the organism and that the entire chelate was absorbed and excreted. The levels of activity in the blood are relatively low, but relatively stable in the first days following contamination; this fact is of practical importance. The determination of the radioactivity of blood might be a good diagnostic guide in the course of estimation of internal contamination, but due to a small portion of the retained activity it is difficult to make accurate conclusions. The determination of radioactivity in the blood under usual conditions can be used as a rapid orientation test. The determination of clearance of radionuclides in the evaluation of therapeutic media during first hours following contamination is a suitable complementary part of the excretion and distribution analysis. (auth)

51476 EFFECTS OF ISOTOPE CARRIER ON THE METABOLISM OF RADIONUCLIDES. Slouka, Vl. pp 244-53 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The effect of the isotope carrier on the metabolism of radionuclides (Slouka) was described. The effects of the isotope carrier upon the metabolism of radionuclides are evident in cases where the increased amount of nonactive element results in a decreased concentration of radio isotopes in the organs of deposition due to the loss of bounding capacity for a given element. Radioiodine was used as an example, in which the administration of a carrier significantly decreased the uptake of radioiodine in the thyroid gland. In radioactive Cs or radioactive Ru similar metabolic properties to potassium were used and an increased amount of potassium in diet for a long period proved to be especially favorable, which in fact caused an increased excretion of radionuclides. The use of isotope carrier in radioisotopes of alkaline metals is of no practical importance. In this respect there is very little known about radiostrontium. The carrier may be effective only when administered in a sufficient quantity to compete with exchangeable Ca-ions in bones. A small quantity of the carrier does not affect the metabolism of radiostrontium at all, however, in greater amounts it is toxic. It follows from the experiments with animals that there exists a certain optimal dose which when exceeded does not show any further strengthening of the effect. In the administration of this dose the binding capacity of the bone for ion exchange and adsorption seems to be saturated. The effect of the carrier is not manifested by an increased excretion. The time of administration of the carrier is critical as well. The carrier may cause a decreased deposition of radiostrontium in bones, when administered during first hours following contamination, but it may not significantly affect the wash-out of Sr from the bones in later intervals. Strontium is bound labilely and it may be exchanged with Ca ions in aqueous phase. Long term fixation of radiostrontium in bones is caused by a very strong bond, based on the mechanism of heteroion exchange with Ca atoms in hydroxyapatite. Liberation from this latter fraction may occur first after recrystallization. Experimental results here revealed that cortrolled diet and other factors, especially those affecting the Ca metabolism have in radiostrontium a greater importance than the isotope carrier. In easily hydrolyzating compounds, the administration of the carrier leads to a change of the distribution of the isotope in the organs. The deposition in the liver increases according to the quantity of the carrier and the deposition in bones decreases. The increased uptake of radionuclides in the liver and spleen observed for example in Ce and Y is not dangerous for the organism because the rate of excretion from these organs is substantially faster than from the bones. The transfer of the radionuclide into these less radiosensitive organs with a rapid elimination from the organ is more suitable from the therapeutic point of view. It is concluded that the administration of isotope carrier as therapeutic medium is effective only in compounds which at physiologic pH easily hydrolyzate. From the fission products there are mostly salts of rare earths and yttrium. Due to the different mechanism of the effect in

radiostrontium more significant therapeutic effect of isotope carrier cannot be expected. The best therapeutic effect was observed after the administration of the carrier up to two hours following contamination. (C.O.)

51477 CHANGES IN BLOOD IRRADIATED IN VITRO. Sebestik, V.; Dienstbier, Z. pp 191-9 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Changes in blood irradiated in vitro are described with emphasis on the effects of high doses of x radiation on blood constituents. In the blood of dogs irradiated by a dose of 2,500, 9,000, 18,000, and 35,000 R during the storage in a refrigerator, the level of plasma hemoglobin, osmotic resistance of erythrocytes, concentration of potassium and sodium in erythrocytes and in plasma, and number of leukocytes and thrombocytes were followed. Blood irradiated by a dose of 20,000 R and stored for a longer time was evaluated as to suitability for transfusion in dogs. Blood was collected from non-irradiated dogs and replaced with 75% of blood irradiated by a dose of 60,000 R. By means of radioactive ^{51}Cr the survival of the erythrocytes of rabbits irradiated by a dose of 40,000 R was followed in non-irradiated rabbits. Significant changes in blood constituents after the application of initial doses of 19,000 R included a slow increase of plasma and hemoglobin level and a small decrease of osmotic resistance of erythrocytes. The state of electrolytes in erythrocytes and in plasma was not substantially changed due to radiation effects. The decrease of the number of leukocytes and thrombocytes was very small as compared with the values measured in non-irradiated blood units. Transfusion of the stored blood irradiated by a dose of 20,000 R did not affect the survival of animals and no posttransfusion reaction occurred. Similar results were observed after the transfusion of blood irradiated by a dose of 60,000 R. Survival of the erythrocytes irradiated by a dose of 40,000 R was not affected. These experiments proved a remarkable resistance of blood in vitro to penetrating radiation. (auth)

51478 POST-IRRADIATION DEOXYCYTIDINEURIA. Parizek, J.; Arient, M. pp 97-106 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

In irradiated laboratory rats a significant increase of the excretion of metabolites of deoxyribonucleic acids in the urine occurred, depending proportionally on the applied dose of radiation. These compounds were easily determined by means of deoxyribose and its compounds (Dische's reaction cysteine and sulfuric acid). This change was found to be specific for cases of irradiation and radiomimetic compounds. A further analysis showed that among the compounds containing deoxyribose excreted in a higher concentration by urine following irradiation, deoxycytidine prevailed. A perfect correlation between the whole-body dose of irradiation and the quantity of deoxycytidine excreted 24 hours following irradiation was noted. A correlation with the findings in human beings after whole-body irradiation is made and a precise method for determining deoxycytidineuria after partial irradiation is described. The possibility of practical application of post-irradiation deoxycytidineuria for diagnostic purposes or for solution of several radiobiological questions (e.g., evaluation of the influence of protective agents during radiation sickness) is discussed. (C.H.)

51479 PASSIVE IMMUNIZATION FOLLOWING IRRADIATION. Kunstyr, I. pp 85-7 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The content of administered antibody was followed in swine, using the commercially produced heterologous and homologous hyperimmune serum against erysipeloidum, after whole-body irradiation with a dose of 510, 630, and 360 R of ^{60}Co γ. The fractionated doses of 360 and 630 R were also applied in the time interval of three days. A modification of a neutralization inhibition test and Wellmann–Kuczer's growth test were used for the detection of antibodies. It was found out that the excretion after administration of antibodies in irradiated pigs was significantly retarded. In the irradiated organisms a slower disturbance of proteins in the administered immune serum than in the unirradiated organisms occurred, which was most probably caused by the change in immune reactions in the organisms following irradiation. No significant differences in experiments with the antibodies administered following whole-body irradiation, fractionated exposure, and single dose were observed. Even the damage caused by a dose of LD_{50} and higher doses did not depress completely the immune mechanisms. (C.H.)

51480 FORMATION OF ORGANIC PEROXIDES IN IRRADIATED ORGANISM. Zicha, B.; Lejsek, K. pp 14-23 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The color reactions with thiobarbituric acid (TBA) were used for estimation of peroxides of unsaturated fatty acids and following the effects of ionizing radiation on its formation in homogenates of liver, kidney, and brain of rats whole-body irradiated at a dose of 600 R. The TBA reaction increased on the 3rd and 6th day following irradiation in homogenates incubated for 1 hour at 37°C temperature. The values of the TBA reaction without previous incubation did not significantly differ from the values of the control group. Ionizing radiation causes most probably the disturbance of antioxidation activity of the investigated tissues or morphological disturbance of cells leads to the formation of compounds which catalyze the TBA reaction. After the irradiation of mitochondrial suspension in vitro at a dose of 10,000 R increased values of the TBA reaction within 15 minutes were observed. In mitochondrial suspensions obtained from rats, whole-body irradiated at a dose of 1400 R, increased values of the TBA reaction within 6 hours following irradiation were noted. The observed compensation achieved within 12 hours corresponds to the general response of the irradiated organism to the effects of ionizing irradiation. (C.H.)

51481 DEHYDROGENASES IN IRRADIATED ORGANISM. Zicha, B. pp 24-30 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The activity of dehydrogenase from liver homogenate and liver mitochondria isolated from rats after whole-body irradiation with a dose of 800 R ^{60}Co γ was studied using the extent of the formation of formazane by enzymatic reduction of triphenyltetrazolium. After the irradiation within 12 hours there occurred a temporary decrease of the activity of dehydrogenases which require pyridinnucleotides as coenzymes. A similar change was observed in isolated mitochondria 24 hours following irradiation. The reduction of triphenyltetrazolium chloride in the endogenous substrate showed no significant change after irradiation, and it was assumed that the reduction does not result in direct damage of enzymatic activity, but rather in a disturbance of coenzymes. (C.H.)

51482 EXCRETION AND UTILIZATION OF ^{32}P AND ^{45}Ca IN IRRADIATED RATS. Kolousek, J. pp 31-9 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelsti, 1966. (In Czech).

The effect of various doses of x irradiation, and the effects of starvation, of scalding, and injections of 2,4-dinitrophenol (2,4-D) on the excretion of ^{32}P, and ^{45}Ca in the urine of rats at time intervals of 6, 12, 24, and 72 hours were studied. Radiophosphorus and radiocalcium were applied separately during half an hour's interval following irradiation. A dose of 10 and 25 R decreased the level of ^{32}P excreted by the urine of rats in comparison with controls. A significant increase in excretion of ^{32}P occurred, and following a dose of 100 R this increase became more remarkable. The increased values of excreted ^{32}P after the administration of doses of 100 and 600 R differed from the values observed in the control animals. Starvation increased the excretion of ^{32}P in the urine of controls and experimental animals as compared with rats that were fed. The significant difference between the values estimated in the irradiated and in the control rats remained unchanged. An increased excretion of ^{32}P after the application of 2,4-D similar to the excretion following the irradiation occurred. A serious scalding provoked another effect, i.e., the excretion of ^{32}P in the urine decreased as compared with controls. Two peaks corresponding to periods of 6 and 8 hours after the i.p. application, in the excretion of ^{45}Ca in the urine of rats were observed in the controls as well as in the irradiated animals. The increased excretion of the ^{32}P in the urine of rats following x irradiation as well as after the application of 2,4-D was attributed to the disturbance of the oxidative phosphorylation mechanism. It was assumed that in the irradiated organism the excreted phosphorus was replaced by calcium. (TSS) (auth)

51483 CHANGES IN THE METABOLISM OF IONS. Rakovic, M.; Bradacova-Ondrackova, J. pp 40-6 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The metabolism of ^{22}Na, ^{86}Rb, and the quantity of inactive chlorides in the urine, in the excrements, in the blood serum, and in the saliva of irradiated rats, were studied. A statistically significant decrease of the excreted ^{22}Na by the urine and excrements occurred during the first days following x irradiation with the dose of 600 and 100 R in rats. A dose of 200 R did not result in a decreased excretion. The amount of sodium excreted in the irradiated rats as compared with the amount of sodium excreted by the excrements was relatively low. The renal excretion of

chlorides following irradiation was decreased similarly during first days, their concentration in the urine and the total excreted amount within 24 hours interval dropped as well. Within the first days following irradiation the concentration of chlorides in the blood serum of rats remained unchanged. Results are in agreement with the literature on the levels of sodium ions in the blood serum of irradiated rats and with the explanation that the renal excretion of sodium and chloride ions is controlled very effectively. An increased concentration of previously administered radiosodium and radiorubidium occurred in the saliva. The mechanism of these changes is apparently different in the two ions. In the case of sodium a disturbance of the active transport of rodded cells of ducts may occur; the increase of rubidium concentration in the saliva is however connected more probably with its increased level in the blood. (TSS) (auth)

51484 IONIZING RADIATION EFFECTS ON ADENINE NUCLEOTIDES IN IRRADIATED ORGANISM. Zicha, B. pp 47-54 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The so-called freezing-stop (frier-stop) method according to Hohorst et al., was used for the estimation of adeninenucleotides in blood cells, livers, and mitochondria isolated from the liver of rats irradiated by a whole-body dose of 1000 R ionizing radiation. In the blood cells in the livers a two-phase decrease of ATP, together with corresponding increase of AMP, was observed; first minimum appeared immediately and the second 24 hours following irradiation. However a significant decrease of ADP in mitochondria was noted in the course of the compensation increase of ATP in the liver. The reaction of the organism following irradiation resulted in a loss of metabolites with subsequent compensation as a result of regulation mechanisms. After this compensation a further decrease followed. This mechanism can be assumed as occurring mostly in radiosensitive tissues, but it is very difficult to demonstrate the evidence of these processes, for the sensitivity of these organs is manifested by early morphological and functional changes. (TSS) (auth)

51485 INFLUENCE OF IONIZING RADIATION ON THE METABOLISM OF SULFUR COMPOUNDS. Neuwirt, J.; Pokorny, Z. pp 55-74 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Results are reviewed from studies in rats on the effects of ionizing radiation on the content of protein sulfhydryl and disulfides; mechanisms of the effects of radioprotective compounds with sulfur content; metabolism of low molecular compounds with sulfur content (methionine, glutathione, cysteamine, taurine, and sulfates) after irradiation; and the excretion of organic and inorganic sulfur in urine after irradiation. It was found that in rats in vivo immediately after irradiation changes of protein sulfhydryls and disulfides, mainly in proteins of radiosensitive tissues, occurred. In these tissues a disturbance of metabolic changes of proteinic sulfur was manifested by early disturbances of incorporation of methionine-^{35}S. It was concluded the radioprotective effects of sulfur-containing compounds are caused by the properties of these compounds, to form disulfidic or other complex bonds with proteins. A special problem arises in the disturbance of the methionine metabolism in the irradiated organism manifested by its increased metabolism to glutathione and bound sulfates in the liver tissue, analogously as in the case of methionine administration in the irradiated organism. In the analysis of the excreted sulfur in the urine it was assumed that taurine excreted at high concentrations by the urine of irradiated animals is formed in the decayed tissues or catabolized sulfur. (C.H.)

Ecology

Refer also to abstracts 51299, 51615, and 53489.

51486 (CEA-BIB-123) BIBLIOGRAPHIC DISCUSSION OF THE PHYSICO-CHEMICAL BEHAVIOR AND THE RADIOECOLOGY OF RUTHENIUM IN HYDROBIOLOGICAL SYSTEMS. Bittel, Robert (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). July 1968. 66p. (In French). (EUR-3863). Dep.

Investigations relating to the behavior of radionuclides with a complex physico-chemistry, and whose fate in the hydrological systems can vary according to the combinations in which they are included were divided into two parts. The first part dealt especially with the physico-chemical aspects of Ru. It was a monograph of the classical characteristics of the ruthenium compounds and particularly of those, saline or complex, that interfere with radiochemical and radio-ecological problems (compounds of nitrosylruthenium, tetraoxyde, etc.). The analytical aspect had special stress on the methods and techniques of separation and concentration of ruthenium and identification of different species of ruthenium (particularly the physical methods as for example the infra-red spectrometry). The second part examined the behavior of ruthenium in water, aquatic organisms, or in soils. Determination of the sensitive or critical ways of transfer of ruthenium to the aquatic food chain was attempted. (C.O.)

51487 EFFECTS OF CHRONIC GAMMA IRRADIATION ON PLANT COMMUNITIES. Woodwell, G. M.; Whittaker, R. H. (Brookhaven National Lab., Upton, N. Y.). Quart. Rev. Biol., 43: 42-55 (Mar. 1968). (BNL-11885).

Responses to γ irradiation were studied in four types of plant communities: a forest, an abandoned field, and in the shrub and lichen communities of the forest. The forest is an oak-pine stand dominated by white oak (Quercus alba), scarlet oak (Q. coccinea), and pitch pine (Pinus rigida). The communities were exposed to chronic irradiation by γ sources that produced approximately equivalent radiation fields. Irradiation of the forest was with 9500 Ci of ^{137}Cs; that of the field with 3000 to 4000 Ci ^{60}Co. Both sources were shielded four hr daily. In all communities irradiation reduced community structure toward the lowest strata or growth-forms of the community. Dominant species replaced one another along the gradient of radiation intensity producing population curves similar to those found along natural environmental gradients. Significant changes in productivity occurred. Species-diversity decreased with increased exposure to radiation. With respect to various tests used in the study, increasing community sensitivity to irradiation was in the sequence: forest lichens, old-field herbs, forest vascular plants. (BBB) (TSS)

51488 ACCUMULATION OF ^{32}P AND ^{65}Zn BY LIVING AND KILLED PLANKTON. Cushing, C. E.; Watson, D. G. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1350. Oikos, 19: 143-5 (1968). (BNWL-SA-974).

Accumulation of ^{32}P and ^{65}Zn by living and killed plankton was determined under near natural environmental conditions in the Columbia River on the Hanford Atomic Products reservation to help evaluate data from an extensive study of the accumulation and transport of ^{32}P and ^{65}Zn by naturally occurring plankton being conducted at a station on the river. Plankton was collected at 5 points along a transect across the river every two weeks to evaluate the seasonal pattern of radioisotope accumulation and the magnitude of radionuclide transport. Living and formalin-killed plankton, collected from above the reactors, were enclosed in plankton nets, floated through the reactor outfall areas, and picked up near sampling stations below the reactors, a total distance of about 34 km. Eight nets each of living and killed plankton were tested. Killed plankton accumulated significantly more ^{65}Zn than living plankton; the opposite was true for ^{32}P. The amount of ^{32}P and ^{65}Zn accumulated by the living experimental plankton was much less than that of natural plankton in the same area. Higher radioactivity of the naturally occurring plankton may be due to the inclusion of detached periphyton from the river bed within the reactor areas above the sampling location; this material would not be included in the test plankton collected above the reactors and enclosed in the nets. (BBB)

51489 EFFECT OF CLAY MINERALS ON CONTENT OF ^{90}Sr IN OATS. Gulyakin, I. V.; Yudintseva, E. V.; Levina, E. M. Izv. Timiryazev. Sel'skokhoz. Akad., 1: 77-84 (1967). (In Russian).

The afteraction of lower doses (30 g) and the effect of higher doses (60 and 100 g) of minerals on the availability of radiostrontium to plants have been studied. Montronite, askanite, bentonite, gumbarine, and kil, belonging to montmorillonite group of minerals and clays reduce the radiostrontium supply to plants and its accumulation in the crop much more than minerals of the groups of micas, hydromicas, sesquioxides and especially those of kaolinite group do. Different micas and hydromicas produce different effects on ^{90}Sr supply to plants. Vermiculite, hydroflogopite glauconite, flogopite and biotite reduce the accumulation of radiostrontium in plants, though not so much as clays and minerals of montmorillonite group, but muscovite and damurite do not practically reduce the content of ^{90}Sr in oats crop, which seems to be due to the difference in their crystal-chemical characters. (auth)

Genetics and Cytogenetics

Refer also to abstracts 51440, 51445, 51670, 51827, 51871, 51874, 51875, 51945, 52029, 52031, 52050, and 52051.

51490 (ORO-3014-3) EFFECTS OF RADIATION ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR

PHYSICAL AND BIOCHEMICAL SYSTEMS. Progress Report, September 1, 1967–May 1, 1968. Alexander, Mary L. (Texas Univ., Austin). Contract AT(40-1)-3014. 14p. Dep. CFSTI.

Progress of the programs on dose fractionation studies on spermatogonia of Drosophila melanogaster and combined x-ray and ethylenimine treatments for induction of mosaic mutations is reported. Initial studies on mutagenic potentialities of DNA feeding for Drosophila are discussed. (B.S.L.)

51491 (UCRL–18404) GENETIC CONTROL OF LETHALITY AND MUTATION IN SACCHAROMYCES CEREVISIAE. Resnick, Michael A. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1968. Contract W-7405-eng-48. 173p. Dep. CFSTI.

Thesis.

Eight radiation-sensitive mutants of Saccharomyces cerevisiae were isolated: three were ultraviolet-light (uv) sensitive; four were x-ray sensitive, and one was uv and x-ray sensitive. Some of the mutations prevented sporulation. The uv-sensitivity genes were centromere-linked. One (uvs 1) was 19.5 centimorgans from the centromere of chromosome XVI and the other (uvs 9) was 23 centimorgans from the centromere of a newly identified chromosome XVII. Sensitivities and genetics of the mutants were compared to those reported by other investigators. It was concluded that there are at least 13 genes in yeast that affect sensitivity to radiation. Based on these comparisons and experiments, a model is proposed for the repair of radiation damage. (C.O.)

51492 (UCRL–18432) CHROMOSOME ABERRATIONS PRODUCED BY NEUTRONS. Hittelman, Walter N. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1968. Contract W-7405-eng-48. 149p. Dep. CFSTI.

Thesis.

The formation of aberrations in the chromosomes of plant and animal cells following irradiation by neutrons was discussed. A general study of chromosome aberrations produced by other types of radiation was included also. The literature search examined the following topics: chromosome structure, causes of breaks, chromosome repair, formation of aberrations, linear energy transfer and relative biological effect considerations, aberration kinetics, and oxygen considerations. (C.O.)

51493 DOMINANT EFFECTS OF RECESSIVE LETHALS IN MICE. **Luening, K. G.; Sheridan, William (Lab. of Radiation Genetics, Stockholm). Hereditas, 59: 289-96(1968).**

An examination was made of male offsprings of irradiated animals to detect males suspected of irradiated animals to detect males suspected of being heterozygous for recessive lethals. From such heterozygous males, offsprings were subjected to further analysis. From the ninth generation of a population in which female mice had been irradiated with chronic doses of γ irradiation during periods of their embryonic development, the male offsprings were tested to determine whether or not they were heterozygous for recessive lethals. F_2 sons to 11 F_1 males suspected of being lethal bearers were outcrossed to CBA strain females and dominant effects studied, the F_2 males were then back-crossed to their F_2 daughters to determine if they were normal or lethal bearers. Comparison of the dominance tests for lethal-bearing F_2 males with those of normal brothers gave no overall indication of dominant deleterious effects. Offspring from one F_1 male showed, however, some deleterious dominant effects. (BBB)

51494 PROBLEMS OF GENETIC RADIATION HAZARDS IN MAN. **Schulte-Brinkmann, W.; Vieten, H. (Univ., Duesseldorf). Deut. Med. Wochenschr., 92: 1359-64(July 28, 1967). (In German).**

The authors discuss the nature of genetic radiation injuries, the possible sequence of their occurrence, and questions as to whether there is a radiological mutation threshold. Several examples of studies and experiences with populations exposed to irradiations are reviewed and used to illustrate the possibilities of radiogenic genetic injuries, their types, and the periods of time that may be associated with their manifestations. The results suggest that the total gonadal dose received collectively by a population is more significant than the amounts of irradiation received by an individual. The problem of whether there is a proportionality between irradiation exposure and genetic damage or if there is a mutation threshold is discussed. The effects of time, wavelength, and other factors on the genetic effectivity of irradiation are discussed, and compared with the results of experimental animal studies. The roles of factors such as gonadal recovery times, cell morphology, and pH in genetic injuries are discussed. Effects of irradiation exposure from diagnostic x-ray procedures on the incidence of genetic mutations are also discussed. (BBB)

51495 VETERINARY MEDICINE AND THE NUCLEAR SCIENCES. II. THE EFFECT OF RADIATION ON THE GENETIC CODE AND THE SYNTHESIS OF SPECIFIC PROTEINS. Bruyere, P. (Ecole de Medecine Veterinaire, Brussels). Ann. Med. Vet., 109: 585-611(Dec. 1965). (In French).

The effect of ionizing and nonionizing radiation on genetic factors in animals is reviewed. The action of radiation on the gene is described on the basis of the nature of the gene, the structure of DNA, the genetic code of DNA, and the concept of the gene at the molecular level. The mode of action of uv irradiation (especially 2000 to 3000 Å) is also discussed in terms of the nature and characteristics of biologically active uv rays and the interaction of uv with DNA, especially cytosine and thymine. The topography of natural mutations or those induced by radiation or other mutagenic agents is considered. Also discussed is the effect of radiation on the replication of the gene. The 3 biological effects and their implications which have been observed in irradiated thymine are examined: blocking of replication or defective replication, inability of DNA to serve as a model for new DNA, and destruction of genetic coding function of DNA. The phenomenon of photoreactivation is explained, and the effect of radiation on the synthesis of specific proteins is analyzed in detail. (BBB)

51496 COMPARATIVE STUDY OF MUTAGENIC EFFECTS OF VARIOUS TYPES OF RADIATION AND ETHYLENIMINE ON CHLORELLA ALGAE. **Khropova, V. I.; Kvitko, K. V.; Zakharov, I. A. (Leningrad State Univ.). Issled. Genet., 2: 69-76(1964). (In Russian).**

In experiments with x rays (40 KV at 8000 R/min) the Chlorella cells were of 2-day growth. Cells of 4- to 7-day cultures were used in experiments using uv radiation (4 to 5000 lux illumination from fluorescent lamps; intensity 50 erg/mm^2/sec). Ethylenimine at concentrations of 1/800, 1/1,000, 1/2,000, and 1/4,000 was also tested as a mutagen. It was found that the frequency of appearance of induced pigment mutations (white and yellow colonies) in cells of Chlorella vulgaris was directly dependent on a percentage of surviving cells after irradiation. The x rays and ethylenimine were most effective when used at doses lethal for less than 90% of the cells. The uv radiation appeared to be more effective than the other mutagens at lethal dose. The mutation spectrum was similar for all three mutagens, but relative amounts of white and yellow mutants were different for each mutagen. (BBB)

51497 EFFECTS OF LOW-LEVEL X RADIATION ON CHROMOSOMES. **White, Stuart C. (Univ. of California, Los Angeles). J. Dent. Res., 46: 1177-81(Nov.-Dec. 1967).**

The described experiments were designed to obtain information on the effects of dental diagnostic doses of x radiation on chromosome structure of cells exposed in vivo. The everted cheek pouch of Chinese hamsters was irradiated with 0.25, 2.9, and 5.4 R. Two hr after exposure, the pouches were biopsied and the tissue prepared for chromosome study. Analysis included determination of the number and types of lesions in the chromosomes, including breaks, deletions, and exchangers. All doses of radiation produced significant amounts of chromosomal damage. The relation between the number of aberrations per 100 cells and the exposure level was linear but not directly proportional. The coefficients of aberration production were inversely related to dose level. Other work on radiation-induced chromosome aberrations has indicated a lack of a threshold phenomenon down to the 5 R level; the present data extend this dose level down to 0.25 R. Although the dose levels of x radiation used in this study correspond to those used in dental radiography, the clinical significance of the results remains to be elucidated. The data suggest an apparently greater efficiency in the production of chromosomal aberrations at lower dose levels. Other factors, however, such as a chromosomal rejoining mechanism or alteration of the normal progression of cells through the compartments of the cell cycle, may be more logical explanations to account for this finding. (BBB)

51498 MUTATION INDUCTION BY EMS IN AUTOTETRAPLOID BARLEY. **Krishnaswami, R. (Indian Agricultural Research Inst., Coimbatore). Proc. Indian Acad. Sci., Sect. B, 67: 125-8(Mar. 1968).**

The mutagenic efficiency of various ionizing radiations (fast neutrons, γ rays and x rays) and a chemical mutagen, ethylmethane sulfonate (EMS), was compared on induced autotetraploid barley. Dry, dormant seeds of diploid and autotetraploid barley (var. N.P. 13) were exposed to fast neutrons at a flux of 6×10^5 n/cm^2 sec at 3 doses viz., 10, 12, and 14 hr; γ rays from ^{60}Co for doses of 16, 22, and 30 KR; and x rays for doses of 16, 22, and 30 KR. Other seeds were presoaked for 4 hr at 25°C and treated for 12 hr with 0.1% EMS. The M_2 seedlings were screened for chlorophyll mutations. Of about 7000 M_2 seedlings in the irradiated groups, no chlorophyll mutants were seen. The data showed that in autotetraploid barley the only effective mutagen was EMS. A large control population failed to show any abnormal seedlings. Another observation was that whereas for the diploid the predominant type of chlorophyll mutation was albina, no such mutant

was observed in the autotetraploid. Viridis, maculata, and xantha were the mutants observed in the latter. It appears that there is a basic difference in the mechanism of mutation induction by alkylating agents (EMS) and radiations. The results suggest that the genetic diploidization of induced autopolyploid crop plants may be more effectively achieved using chemical mutagens than with ionizing radiations. (BBB)

51499 RADIATION INJURY AND HEREDITY. **Fuchs, G. (Zentralroentgeninstitut des Kaiser-Franz-Josef-Spitals, Vienna). Deut. Gesundheitsw., 20: 2037-42(Nov. 11, 1965). (In German).**

The overwhelming majority of gonadal muations caused by direct exposure to ionizing irradiation is biologically deleterious. Numerous examples of irradiation effects of this type induced in experimental studies and of the results of studies on populations exposed to irradiations from atomic explosion are discussed. The question of quantitative relation between gonadal irradiation and mutation rate, and the possible roles of several cell components in producing irradiation effects are included. The great importance of genetic irradiation injury to whole populations was compared to its frequency of manifestation in individuals. Reports indicated that the annual gonadal dose was from 50 to 100 mR in the United States, and 20 to 40 mR annually in England, Denmark, and Sweden. Genetic injury from x-ray therapy, from internal use of radioisotopes for diagnostic purposes, and from industrial applications of irradiations or in power production were small. (TSS) (BBB)

51500 CHROMOSOME ABERRATIONS INDUCED BY RADIATIONS AND CHEMICALS. **Goud, J. V. (Univ. of Agricultural Sciences, Bangalore, India). Genet. Iber., 19: 143-56(1967).**

Seeds of different varieties of bread wheat (Triticum aestivum) were treated with doses of 20 and 30 KR of ^{60}Co γ rays, fast neutrons at a flux of 10^9 n/cm^2 sec for 10, 12, and 14½ hr, and EMS (ethylmethane sulfonate) at dilutions of 1/300 and 1/400. The M_1 generation was grown along with controls, and meiosis was studied in plants selected at random from the M_1 generation. The chiasma frequency was usually less than that found in the controls after all the treatments except in EMS 1/400 which showed a lower multivalent frequency. In neutron-treated plants there was a direct correlation between the dose and multivalent frequency. Only quadrivalents and trivalents were observed in most cells, the range varying from 0 to 1 per cell in both cases. At anaphase I, plants treated with neutrons for 10 hr showed abnormalities such as lagging chromosomes in about 1.5% of the cells and chromatin bridge in 0.75%. However, plants treated with neutrons for 12 hr exhibited laggards, chromatin bridges, and sticky chromosomes in about 12%, 0.75%, and 1.5% of the cells, respectively. In all the neutron-treated plants, many fragments of variable size were commonly noted. The highest frequency of quadrivalents was observed in γ-ray-treated plants. The multivalent frequency was higher in the 20-KR treatment group than in plants treated with 30 KR. Plants treated with the higher concentrations of EMS (1/300) showed varying numbers of pentavalents and quadrivalents although trivalents and univalents were common. It was concluded that fast neutrons produced severe chromosome aberrations leading to rearrangements, multivalents, fragments, and laggards. Gamma irradiation, although equally potent in producing chromosome breakage, was less efficient compared to fast neutrons. Mostly deletions and deficiencies and also localized chromosome aberrations were produced by EMS as evidenced by the frequency of isochromosomes, pseudoisochromosomes, and univalents. (TSS) (BBB)

51501 THE INDUCTION BY SOMATIC MUTATIONS IN EPHESTIA BY INJECTION OF MUSTARD GAS SOLUTION. **Loebbecke, Ernst-Arnold (Univ., Cologne). Mol. Gen. Genet., 99: 115-24(1967). (In German).**

Experiments were carried out to compare nitrogen-mustard (HN-2) and x radiation as mutagenic agents for the induction of somatic mutations in Ephestia (Anagasta) kuehniella. When larvae of the last instar were injected with different concentrations of HN-2, several mutant scales of the same types as observed after x-ray treatment were noted. However, the HN-2-induced mutation spectrum differed significantly from the x-ray-induced spectrum. The concentrations of HN-2 used to produce mutants were 1, 2, 3, and 4 mg/10 ml, at which the mutant frequency was 0.4, 1.4, 1.3, and 1.5% compared to 0.03% in the untreated controls. A 400-R dose of 100-KV x rays was used to produce the radioinduced mutants. (BBB)

51502 YIELD REACTIONS AND RATES OF ORIGIN OF CHROMOSOME REARRANGEMENTS AND GENE MUTATIONS IN BARLEY. **Gustafsson, Ake; Lundqvist, Udda; Ekberg, Inger (Royal Coll. of Forestry, Stockholm). Hereditas, 56: 200-6 (1966).**

Effects on grain yield of chromosome changes in mutant varieties of barley induced by uv, x, γ, and neutron irradiation or chemical agents were summarized. The following test series were included: A mutant assortment of 123 translocation lines induced in Bonus variety barley, by uv and x irradiation of pollen (mutant strains designated UVPT and XPT); γ, x, and neutron irradiation of seed (γT, XT, NT); chronic γ irradiation of growing plants (γcT); oxygen treatment under pressure (OT); a yield trial of 65 Bonus translocations in 3 replications: 2 UVPT, 20 XPT, 19 XT, 9 NT, 7 γaT of seeds, 9 γcT (growing plants), 1 OT; a yield trial of 28 Foma translocations in 3 replications: 18 XT, 6 NT, 4 CT (C stands for chemically induced); a yield trial of Foma translocations in 3 replications: 2 XT, 1 NT, 1 CT; and a yield trial of 11 translocation lines (with sublines) from Mari, Pallas, Ingrid, and Domen barley varieties in 3 replications: 11 XT. Analysis of the productivity of these translocations and inversions, compared to the parent strains, gave the following results: average yield of translocation lines 95.2%, 98.0%, 98.2%, 97.2%, and 97.7%. The 108 translocation lines of experiments 2 to 5 produced 98% as a mean in comparison to their 6 parent varieties. Among the field aberrations, there were 2120 cases of sterility. One-third to ½ of these comprised chromosome translocations that were random as to the rate and characteristic for individual mutagens. Their frequency was higher with ionizing radiations than with chemical compounds like ethylenimine. The points of breakage were considered to be different with ionizing radiations and chemical mutagens. (BBB)

51503 VALUABLE MUTANTS OBTAINED AS A RESULT OF IRRADIATION OF COTTON PLANTS. **Ibragimov, Sh. I.; Kovalchuk, R. I.; Paiziev, P. Khlopkovodstvo, 3: 35-8(Mar. 1967). (In Russian).**

Radiation treatment of cotton plants in the budding stage, with developed leaves and in a fluorescent state, was applied as a single large dose of 500, 1000, 1500, 2000, 2500, or 3000 R of x rays. The results showed that irradiation of cotton plants during vegetative stages of the 1st generation (M_1), and in various phases of ontogeny, induced drastic changes of organogenesis. However, radiation effects on cotton plants in the 3rd and 4th phases, including those in a budding stage and with developed leaves, induced a two-phase response. That is, the acute exposure to a high dose in a range of 1500 to 3000 R resulted, at first, in a considerable suppression of growth, but as plants continued to grow radiation effects gradually were less apparent. No observable morphological effects were detected in cotton plants after irradiation during fluorescent stages. Cotton plants irradiated with 1500 to 3000 R in the 2nd generation (M_2) were stimulated to produce a greater diversity of shapes, and among them many new varieties appeared that were suitable for future plant breeding studies. Thus, a 7-yr research program based on a selection of cotton plants from the M_2 and M_3 generations resulted in a production of four mutants that were distinguished by a compact heavy growth, by larger bolls, and by cotton fibers of high technological quality. A detailed description of each mutant is provided in the text. It is pointed out that the radiation treatment used allowed changes to be introduced in the nature of cotton plants during the budding and fluorescent stages, during the formation of zygospores in the reproductive organs. These developmental stages appeared to be highly sensitive to radiation, which affected the normal course of development and led to heterogeneity of seeds and plants. (BBB)

51504 THE MUTAGENIC EFFECT OF ETHYLMETHANE SULFONATE ON THE COMPLEX HETEROZYGOTE OENOTHERA BERTERIANA. **Kressel, Maria; Arnold, Carl-Gerold (Univ., Erlangen-Nuremberg, Ger.). Zuechter, 37: 364-71(1967). (In German).**

Effects of chemical (ethylmethane sulfate, EMS) and physical agents (x rays) on mutation in O. berteriana were compared. Seeds treated with a 1% solution of EMS showed 100% lethality. After the application of a 0.1% solution, however, all surviving plants of the M_1 generation were mutants. There was no doubt that the mutagenic effect of EMS exceeded that of x rays. This was also confirmed by the higher number of viable mutants in the following generation. While there were mainly translocations among the X_1 mutants following x irradiation, after EMS treatment there were no translocations at all. Only small, barely visible aberrations were caused by EMS. With regard to the kind of the chromosome mutations, a clear difference between x radiation and EMS treatment was noted. In the progeny of X_1 mutants caused by x rays there were many trisomic plants, whereas in the progeny of diploid EMS mutants trisomic forms were completely absent. So the assumption was confirmed that translocated chromosomes are responsible for the increasing of nondisjunction that finally leads to the occurrence of trisomic plants. (BBB)

51505 SOMATIC MUTATIONS IN WING SCALES OF THE DRIED FRUIT MOTH PLODIA INTERPUNCTELLA HUEBNER AFTER X IRRADIATION OF THE CATERPILLARS. **Von Aufsess,**

Gerlore (Heiligenberg-Institut, Mainz). Arch. Entwicklungsmech. Organ., 158: 124-46(Jan. 12, 1967). (In German).

Somatic changes in the scales located on the superior side of the rear wing of the dried fruit moth Plodia interpunctella following x irradiation of the caterpillars at various ages at doses of 1000 to 7000 R were studied. The frequency of appearance of 10 phenotypes produced varied considerably, but the one most often observed was an abnormally small, dark scale with a rounded distal border. The greatest numbers of x-radioinduced scales were found in wings of the heterogametic females and only rarely in the males. The ratio of abnormal scales in moths from irradiated caterpillars irradiated during stage 4 to those irradiated in final portions of stage 5 was 12.6:1. The overall ratio for all irradiation induced mutations was 10.05:1. The mutations induced in young animals tended to form clusters; this was probably related to the state of cell division. The frequency of clustering decreased for all mutants and irradiation stages as the number of scales increased. The mutants showed a wide range of tendency to form clusters. Equivalent irradiation doses produced more mutations in migrant organisms than in moths irradiated at median stages. This was probably due to the larger number of cells in the imaginal layers of the migrant organisms. Several abnormalities, including extra veins, reduction of veins, double scales, and giant scales were observed after the x irradiations. (BBB)

51506 STUDIES ON AN INTERESTING SACCHAROMYCES CARLSBERGENSIS MUTANT. Ahmad, Majeed; Ahmed, Zia Uddin (Univ. of Dacca, Pakistan). Mycopathol. Mycol. Appl., 35: 27-32(May 13, 1968).

A single spore culture, obtained from a local Baker's yeast strain of S. carlsbergensis, proved to be a double mutant for an amino acid and a pyrimidine. It required lysine as well as uracil or cytosine for growth. It failed to utilize thymine and 5-methylcytosine. It thus possessed the capacity of amination and deamination of pyrimidines and of coupling uracil and cytosine with ribose, but lacked the ability to demethylate pyrimidines. Two other uracil-less mutants of S. carlsbergensis, one induced by x rays and the other by uv behaved in the same way as the spontaneous double mutant in respect to the utilization of uracil, cytosine, thymine, and 5-methylcytosine. The single spore culture, 26a, from strain 60 C 92 was redesignated as H1a. Of the 2 uracil-less single-spore cultures, the one designated, 96E 6 ch X 4, or J1 was obtained by x ray treatment and that referred to as XVI/3 or D1 was obtained by uv treatment. (BBB)

51507 INFLUENCE OF X IRRADIATION ON MICROSPOROGENESIS IN DI- AND TETRAPLOID SUGAR BEETS. Kuzdowicz, Alfons (Inst. for Breeding and Acclimatization of Plants, Bydgoszcz, Poland). Tagungsber., Deut. Akad. Landwirtschaftswiss. Berlin, 73: 65-8(1966). (In German).

X irradiation in doses of 1, 5, 10, 20, and 30 KR of sugar beet seedlings in the premeiotic and meiotic stages of division caused diploid plants to form not only normal haploid pollen grains, but also diploid and aneuploid ones. Diploid and large quantities of haploid pollen were observed in tetraploid plants. They did not form normal tetrads, but polyads with 6, 8, 12, and 16 much smaller cells which, after having been exposed to maximum irradiation doses, were found to be very small and entirely sterile. Seedlings with pollen which was similar to that of octoploid plants occurred in the X_2 generation of the tetraploids. The octoploids were obtained by colchicine treatment. The reaction to x rays of tetraploids seems to be less marked than that of diploids, in agreement with other authors, due to better seed setting and germinating capacity. The results indicate that various types of radiation sources may be considered suitable means for the formation of natural (meiotic) tetraploids and polyploids of high genome stages. (BBB)

51508 CHEMICAL COMPOSITION OF CELL-WALL POLYSACCHARIDE OF ROUGH MUTANTS OF SALMONELLA TYPHIMURIUM. Holme, T. (Karolinska Institutet, Stockholm); Lindberg, A. A.; Garegg, P. J.; Onn, T. J. Gen. Microbiol., 52: 45-54(June 1968).

Ultraviolet-induced mutants were isolated by picking rough-looking colonies from broth cultures of the S. typhimurium strain 395^{MS}. The mutants 395^{MR1-R4} were prepared from an 18-hr culture of the parent strain subjected to uv irradiation so as to obtain ~0.1% survival. Ten 0.05-ml portions from the uv-treated suspension were each inoculated into 10-ml nutrient broth. From these cultures rough mutants were isolated after incubation at 37° for 2 weeks. Mutants with different antigenic patterns in the gel precipitin test were chosen for further study. Quantitative analyses of monosaccharide constituents of the cell-wall polysaccharide of the smooth form and rough mutants were made by gas-liquid chromatography of glycitol acetates produced from acid hydrolysates of phenol + water extracts of cell-wall preparations. The presence, in varying amounts, of sugars characteristic of the S-specific repeating unit was detected in all rough mutants investigated. Definite conclusions about the core structure of the different rough mutants could not be drawn by using the basis of the monosaccharide composition of the cell-wall polysaccharide. Ribose was found in the cell-wall polysaccharide of the smooth form in small amounts. (BBB)

51509 EVIDENCE OF TRANSFORMATION IN MICROCOCCUS LYSODEIKTICUS. Okubo, S.; Nakayama, H. (Osaka Univ. Kyushu Univ., Fukuoka). Biochem. Biophys. Res. Commun., 32: 825-30(Sept. 6, 1968).

Mutants of Micrococcus lysodeikticus sensitive to uv radiation were used to obtain evidence for the occurrence of DNA-mediated transformation. Transformation was found to occur at low frequencies in strain (G), no. 4698 of ATCC, but not in strain (S). A definite procedure yielding good competence was not established. (B.S.L.)

51510 TRANSFORMATION OF RADIATION SENSITIVE STRAINS OF MICROCOCCUS LYSODEIKTICUS. Mahler, Inga; Grossman, Lawrence (Brandeis Univ., Waltham, Mass.). Contract AT(30-1)-3449. Biochem. Biophys. Res. Commun., 32: 776-81(Sept. 6, 1968).

The properties of three selected mitomycin sensitive mutants of Micrococcus lysodeikticus that were also uv-radiosensitive are described. The transformation of these mutants with wild type DNA is also described; the characteristics of these transformants are presented. (B.S.L.)

51511 COMBINED EFFECTS OF X RAYS AND STREPTOMYCIN ON THE MUTABILITY OF CHLORELLA ALGAE. Tugarinov, V. V.; Kuznetsov, V. V. (Leningrad State Univ.). Tr. Mosk. Obshchest. Ispyt. Prir., Otd. Biol., 22: 163-9(1966). (In Russian).

Three strains of Chlorella exposed to x irradiation alone, failed to render a statistically significant number of mutants. The same strains, B(SS) that is streptomycin sensitive, Sr-500 that is resistant to 500 units/ml of streptomycin, and Sr-3000 that is resistant to 3000 units/ml of streptomycin were treated during the postirradiation stage with a nonmutagenic dose of 20 units/ml of streptomycin. Strains B(SS) and Sr-500 showed a significant increase of mutants, but not strain Sr-3000. The mutagenic effects are discussed in terms of the ability of streptomycin to induce biochemical and morphological changes in the plastid apparatus of nuclei; also, in terms of the capacity of streptomycin to form complexes with nucleic acids and also form chelates with magnesium and penetrate the chlorophyll molecule to induce plastid mutations. (TSS) (BBB)

51512 INDUCED MUTATIONS AS A TOOL FOR IMPROVING WORLD FOOD SOURCES AND INTERNATIONAL COOPERATION IN THEIR USE. Sigurbjoernsson, Bjoern (IAEA, Vienna). Hereditas, 59: 375-95(1968).

The primary objective of the Neutron Seed Irradiation Program is standardization of methods of exposing seeds to neutrons in reactors and of measuring and reporting doses. Under contract with the IAEA and in collaboration with FAO/IAEA staff, the Austrian Atomic Energy Research Organization developed a seed irradiation facility, using a lead and boron pot with a revolving specimen capsule, for use in pool-type reactors. Recommendations for standardized methods of measuring and reporting of doses are given. Contracts have been concluded with several countries (India, Thailand, Philippines, Bulgaria, and Austria) to install the irradiation facility and to carry out coordinated studies. Several additional countries are expected to join the program during 1967. The IAEA Laboratory at Seibersdorf is testing a technique of using barley seedling growth as an indicator of biological response for comparing different reactors. Other studies in this program will include radiosensitivity to neutrons of crop species and the use of neutrons for induction of useful mutations. A rice mutation breeding program is also described, and research projects of the plant breeding and genetics unit of the IAEA Seibersdorf laboratory are outlined. Various projects on mutagenic effects of γ and neutron irradiation are being carried out, particularly relating to neutron dosimetry and the measurement of biological effectiveness of the various types of ionizing radiations in reactors. The main objectives are comparison of chemical mutagens with ionizing radiations including effect of combination treatments. (BBB)

51513 STUDIES OF INDUCED MUTATIONS IN PEAS. XXIV. GENETICALLY CONDITIONED DIFFERENCES IN RADIATION SENSITIVITY 2. Blixt, Stig (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Hereditas, 59: 303-26(1968).

Recessivity in some genes, or possibly recessivity in general,

seems to be important for determining the level of radiation sensitivity in peas. Radiation experiments comprising 34 different genotypes were performed to establish a firmer basis for the planning of further experiments on radiosensitivity of Pisum varieties. One series received γ-ray treatment in doses of 0.5, 2, 4, 8, and 20 Krad, and another neutron treatment in doses of 0.05, 0.2, 0.4, 0.8, and 2 Krad. The characteristics studied as factors determining the radiation sensitivity were the number of days from sowing to flowering, number of days from sowing to maturity, number of recessive genes, and individual genes. Results showed that radiosensitivity in peas was determined by the number of recessives in a line, and that radiosensitivity was connected with the duration of the life-cycle or some other aspect of earliness. Of the 62 genes studied, as regards single genes, it was found that the gene A exerted a major influence on radiosensitivity after irradiation with γ rays, lines recessive for a being much more sensitive. A different response to neutron irradiation was possibly indicated, but this needed confirmation. Other genes also influenced radiosensitivity after γ irradiation, though none to the same degree as A. None of these genes displayed any clear differential response to neutron irradiation (one exception: gene M). Among these genes, the existence of different patterns of response to irradiation was noted. In the most common pattern, in lines dominant in A the lines recessive for a certain gene were more sensitive than the lines dominant for the gene in question, and in a lines, the condition was reversed, i.e., the dominant lines were the most sensitive. The number of recessive alleles did not affect neutron irradiation sensitivity but did influence γ-irradiation sensitivity. In A lines, sensitivity increased with increasing number of recessives; in a lines sensitivity decreased with increasing number of recessives. After neutron irradiation neither the duration of the period from sowing to flowering nor the length of the period from sowing to maturity was correlated with radiosensitivity. After γ irradiation some indications were found of an influence of the duration of these periods on radiation sensitivity, thus the longer the life cycle, the more sensitive the line. It is concluded that genetic factors did not as a rule influence radiosensitivity after irradiation with fast neutrons but did influence it after γ irradiation. (BBB)

51514 HUMAN CHROMOSOMAL BREAKAGE. German, James (Cornell Univ., New York). J. Pediat., 72: 440-2(Mar. 1968).

Chromosome breakage by ionizing radiation and other agents is discussed. The circulating blood cells of individuals therapeutically irradiated, e.g., those with spondylitis, have increased numbers of aberrant or broken chromosomes not only immediately but also for many years following their treatment; furthermore, this group is known to have an increased expectancy of malignancy. Genetic constitutions, drug usage, infections, and previous radiation must all be considered in each individual examined. Data are needed which will indicate whether or not the findings of breakage in vitro reflect increased breakage in vivo. (TSS)

51515 RADIOSENSITIVITY OF CHROMOSOMES IN DIFFERENT ORGANS OF MICE EMBRYOS OF THE STRAINS BALB, $C_{57}Bl$ AND THEIR RECIPROCAL HYBRIDS. Osetrova, T. D.; Kerkis, Yu. Ya. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Genetika, 4: No. 8, 58-62(Aug. 1968). (In Russian).

In highly specialized functionally mammalian cells the general radiosensitivity is not always correlated with that of the chromosomes of such cells in vivo. This is probably the source of the controversy on this point in the literature. The object of this study was the radiosensitivity of chromosomes in the liver, muscle, kidney and intestine cells of mouse in the radiosensitive strain BALB and in the radioresistant strain $C_{57}Bl$ and in their reciprocal hybrid embryos 16 days after fertilization. The existence of correlations between the general radiosensitivity of liver cells and those of the chromosomes of these cells was established. The liver cells proved to be more sensitive to radiation as compared to the cells of the other organs studied. No differences in the chromosome radio-sensitivity of the muscle, kidney and intestine cells were observed either within the same pure or hybrid strain or between strains and between their hybrids. The failure to observe any differences in the radio-sensitivity of chromosomes in the liver cells of reciprocal hybrids suggests that the mutability of chromosomes in embryonic cells depends mainly on the genetical and physiological characteristics of the embryos, but not on the material effect exerted under the intrauterine conditions. (auth)

51516 STATISTICAL TESTING OF DIFFERENCES IN CAUSAL BEHAVIOR OF TWO MORPHOLOGICALLY INDISTINGUISHABLE OBJECTS. Urbakh, V. Yu. (Ivanovsky Inst. of Virology, Moscow). Biometrics, 23: 137-43(Mar. 1967).

The problem considered is that of testing, given observations on a sample of cells, the null hypothesis that the paternal and maternal chromosomes in a particular pair behave similarly (e.g., have the same DNA synthesis rate, or the same sensitivity to radiation). Two models are considered, one in which ionizing radiation or other stimulus can conceivably affect either chromosome of a pair, and one in which it can affect at most one (for example, a particular labeled molecule may be used in synthesis by either chromosome, but an ionizing photon on a path intersecting one chromosome will generally be incapable of hitting the other). Tests are suggested for both models. (BBB)

51517 ELIMINATION OF RADIATION-INDUCED CHROMOSOME ABERRATIONS IN EXPERIMENTAL POPULATIONS OF DROSOPHILA MELANOGASTER. Mglinets, V. A. (Inst. of Medical Radiology, Obninsk, USSR). Genetika, 4: No. 8, 81-6 (Aug. 1968). (In Russian).

The behavior of chromosome aberrations originating in experimental numerically stable populations of Drosophila melanogaster was studied. The aberrations were induced by a single simultaneous 5000 R γ-irradiation, fractionated γ-irradiation at 1000 R monthly fractions, and chronic irradiation from a ^{32}P radioisotope source administered with the food. It was observed that chromosome translocations induced by ionizing radiation were eliminated in the first two generations irrespective of the method of irradiation (simultaneous, fractionated or chronic) while out of 66 induced inversions only 7 persisted in the populations for 2 to 5 generations. None of the inversions were firmly established in the populations. Thus most of the chromosome aberrations were eliminated from the populations within one or two generations, and the probability of persistence of any aberration arising anew in a numerically stable population is very small; they are rapidly eliminated on account of the poor viability of their carriers. (auth)

51518 MODIFICATION OF THE GENETIC EFFECT OF GAMMA RAYS AND FAST NEUTRONS BY POST-IRRADIATIVE ACTION OF ATF AND CYSTEINE. Eizenberg, V. T.; Dishler, V. Ya.; Rozenberg, P. S. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis, No. 6, 71-9(1968). (In Russian).

Post-irradiative treatment of air-dry pea seeds with solutions of adenosine triphosphate (ATP) (0.01M) and cysteine (0.01M) considerably lowered the amount of modified chromosomes at first mitosis of pea radicle meristemic cells, induced by γ rays and fast neutrons. The lowering of the amount of modified chromosomes due to combined action of cysteine and ATP in case of seed irradiation with fast neutrons was less marked than at separate treatment with these solutions. In the case of γ irradiation the lowering of the amount of modifications at combined action of cysteine and ATP was statistically unreliable. In majority of cases the protectors (cysteine and ATP) lowered the relative frequency of dual chromosome aberrations (double bridges) yet did not increase the frequency of incorrect links (bridges of all types). The post-irradiative action of ATP and cysteine solutions did not lower the number of M_2 generation seeds and plants with chlorophyll mutations induced by γ rays and fast neutrons. In variants with post-irradiative application of protectors among M_2 generation plants some rare types of chlorophyll mutations were observed that were not found among variants without protector application. The results of the experiment on chromosome protection by means of ATP and cysteine, protectors that do not lower the frequency of chlorophyll mutations and present a wider range of these mutations, indicate the usefulness of further protector study with the aim of working out more effective methods for mutational plant selection. (auth)

51519 CYTOGENETIC EFFECTS OF ^{90}Sr ON THE BONE MARROW OF THE CHINESE HAMSTER. Brooks, A. L.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nature (London), 219: 761-3(Aug. 17, 1968).

An attempt was made to evaluate the influence of an internally deposited radionuclide on the frequency of chromosome aberrations produced and examined in vivo. Strontium-90 was selected for the study since it localizes selectively in osseous tissues, resulting in beta irradiation of both bone and bone marrow. Aberrations in bone marrow cells can be readily studied in vivo, and may also be significant in the development of haematopoietic tissue neoplasms. Intraperitoneal injections of ^{90}Sr chloride or citrate were made, at 0 to 5 μCi per gram of body weight, and one to two hundred marrow cells were scored for chromosome damage for each experimental point. Colchicine solution was injected to block mitosis at metaphase and to facilitate chromosome and mitotic index scoring. Retention of ^{90}Sr was measured by whole body counting on a Packard well liquid scintillation counter. Dose-rate and cumulative dose to the skeleton were calculated. No significant effects were noted on the peripheral erythrocyte indices. Leucocyte counts were depressed at doses >0.2 μCi/g.

Mitotic index values are tabulated. Feulgen stained chromosomes were coded, located under low power and scored at X 1500 on a phase contrast microscope. Numerous chromosome and chromatid aberrations were observed, and are indicated in tabular form. The data suggested that a protracted dose was less effective in producing aberrations than a dose delivered over 2 days. Many of the damaged chromosomes were eliminated at each mitotic cell division, and the number of aberrations may reflect the radiation dose over each cell cycle, rather than the total accumulated dose. Neither cellular cloning nor marker chromosomes were detected in aberrations seen after short periods, but were detectable after longer periods following injection. The number of chromosome aberrations scored depended on total accumulated dose, the mitotic division rate, the relative stability of the aberrations, and the length of time between injection and tissue sampling. At both 2 and 14 days after injection the number of breaks per cell increased with increasing dose. Regression coefficients are given. (UK)

51520 CHROMOSOMAL LOCALIZATION OF CERTAIN ASPOROGENIC MUTANTS OF BACILLUS SUBTILIS MARBURG. **Ionesco, Helene; Schaeffer, Pierre (Institut Pasteur, Paris). Ann. Inst. Pasteur, 114: 1-9(Jan. 1968). (In French).**

Ten sporulation deficient mutants of B. subtilis were produced by uv irradiation, anaerobiosis, or treatment with nitrous acid or N mustard. Five were uv-induced mutants which were isolated after uv irradiation of the cultures to give a survival of 1:1000. Two asporogenic mutants were isolated from auxotrophic derivatives of the Marburg strain of B. subtilis, after transformation with nitrous-acid-treated wild type DNA. One of them, phenotypically sp_0^- ab^- $prot^+$ cpt^+ (phenotype sp_{0B}^-) is linked to a phenylalanine marker; the other, phenotypically sp_{IIB}^- ab^+ $prot^+$ cpt^+ (phenotype IIB), is linked to a lysine marker. The two auxotrophic markers, the map location of which is already known, are genetically unlinked. Two reactions, the mutational block of which interrupts sporulation at cytologically distinct stages, are thus both controlled by unlinked chromosomal genes. The previously considered hypothesis, that the whole genetic information required for sporulation might be carried by an episome, is thus eliminated. (BBB)

51521 CYTOKINETICS. **Oldfield, D. G. (Univ. of Chicago). Bull. Math. Biophys., 29: 597-603(1967).**

Some developments in the interrelation of cell population theory and intracellular kinetics, collectively termed cytokinetics, are reviewed and discussed. Dose-rate dependence of radiation-induced metaphase delay is considered on the basis of a specific stress model. The general assumption is that a stress will alter a rate coefficient through its effects on cell processes or cell components on which the rate coefficient depends. The stress is ionizing radiation, the rate coefficient is that for chromosome shortening during prophase, and the process chiefly affected is the coiling of segments of chromosome fibers. It is assumed that the coiling rate of each segment decreases due to radiation-induced cross-linking of adjacent chromosome fibers. Specializing to the case of linear decrease of rate with cross-link concentration, the radiation dose producing a certain concentration of cross-links can be related to the time required for the chromosome to shorten to its metaphase length. The 2-parameter fit of the calculated curve (for the dependence of metaphase delay on dose) to the experimental points is satisfactory for all doses used. From this fit, the rate coefficient is obtained for repair of cross-links: $\lambda^+ = 0.5\ hr^{-1}$. The value of this rate coefficient determines, for example, the time intervals required between successive acute radiation doses to produce a progressive accumulation of cells in prophase. Such information can be of importance in experimental radiobiology and clinical radiotherapy. The satisfactory fit of the experimental data also sustains the initial assumption that, in unirradiated cells, prophase chromosome length decreases exponentially with cell age. (BBB)

51522 MUTAGENIC EFFECTS OF RADIOTOXINS. **Kuzin, A. M.; Yurov, S. S. (Inst. of Biological Physics, Pushchino, USSR). Radiobiologiya, 8: 456-8(1968). (In Russian).**

The investigation indicated that quinoid radiotoxins extracted from γ-irradiated plant tissue, acting upon E. coli K-12 (λ), induced the formation of auxotrophic mutants. With the procedure used, 12 mutants were formed on 1000 investigated colonies, as compared with 0.6 in the control. The mutants obtained required: proline and serine; serine, alanine, and glycine; serine and xanthine; leucine; leucine, valine, and proline; tryptophan. A large frequency of appearance of proline deficiency was noted (8 out of 16). (JPRS)

51523 FREQUENCY OF DOMINANT MUTATIONS DEVELOPED UNDER THE EFFECTS OF MUTAGENS IN M_1. (REPORT 2). **Sharma, B.; Rapoport, I. A. Dokl. TSKhA (Timiryazev. Sel'skokhoz. Akad.), No. 102: 257-66(1965). (In Russian).**

Mutants were sought in large-fruited pea plants treated with γ rays and fast neutrons, as well as with three chemical agents, ethylenimine (EI), nitrosomethyl urea (NMU), and diethylsulfate (DES), used in various doses. The γ rays and neutrons were also used for irradiation of dry seeds. The results indicated that γ rays and neutrons (doses not given) produced in M_1 (the 1st generation) eight types of mutants but none of economic significance. The EI treatment induced 15 types with a high fertility and a low percentage of other mutant characteristics in the plants, such as changes in chlorophyll content and number of buds. The NMU treatment produced a broad spectrum of changes, seen in 27 types, of which the most notable was one with complete sterility, also chimeric mutants with a mixture of tissues of different genetic constitution and long growing season features. As the incidence of chimeric mutants decreased after increased concentrations of the agents and exposure time, the number of totally changed plants increased. The DES-induced mutants were numerous and essentially alike. Their frequency and distinctness depended on a concentration of the mutagen used, e.g., 0.2 and 0.3% concentrations occasionally produced seedless plants. (BBB)

51524 EVIDENCE AGAINST THE ALTERNATION OF SYNTHESIS OF IDENTICAL CHROMOSOMES IN ESCHERICHIA COLI GROWING AT LOW RATES. **Koch, Arthur L. (Indiana Univ., Bloomington); Pachler, Patricia F. J. Mol. Biol., 28: 531-7 (Sept. 28, 1967).**

Slowly growing cells in medium containing succinate as a carbon source were labeled for about half a generation and about two generations with ^3H-thymine, and the survival on storage at liquid-nitrogen temperature was followed. Cells in both samples were inactivated in a first-order way. The survival curves showed no tendency to level off, even when survival was followed into the fourth decade. This is evidence against alternate synthesis of identical chromosomes in these cells, a conclusion supported by the fact that the final slope of the survival curve was proportional to the amount of self-irradiation of the radiation-sensitive target. The slopes of the survival curves of the long pulse, and of the fully labeled control cells, were proportional to the content of trichloroacetic acid-insoluble ^3H of the cells; but, the alternate synthesis model predicted that the lethal effect would be much less. Thus, it appeared that if death because of tritium decay was recessive, the possibility that these cells possessed two identical chromosomes that replicated alternately was excluded. (BBB)

51525 MICROSCOPIC OBSERVATION OF INDUCED AND VIABLE PROGENY OF A UV-IRRADIATED LYSOGENIC CELL. **Iwo, Kazuhiro; Takebe, Hiraku; Kondo, Sohei (Osaka Univ.). Virology, 33: 647-9(Dec. 1967).**

Microscopic observations of the fate of the descendants during cell division in uv-irradiated lysogenic B_{s-1} (80) cells indicated that only some progeny of a uv-irradiated cell lyse due to phage induction while the other descendants survive and can presumably form a colony. In an unirradiated sample, only one cell among 22 showed lysis without division. Other cells continued to divide without forming filaments during 6 hr of observation. Therefore, most induction events observed in uv-irradiated cells are not spontaneous. In E. coli W3110(80), a derivative of E. coli K12 which is resistant to uv, all observed lytic events after 200 erg/mm^2 of uv irradiation took place without division. Assuming that each cell has at least two nuclei, especially when it is in stationary phase, it is possible that only one was hit by uv, thus yielding both induced and noninduced progeny. This could be readily observed only when the cells were irradiated with very low doses, as in B_{s-1} (80). Segregation of viable and induced cells among the progeny of a uv-irradiated cell could account for the lack of extra sensitivity in B_{s-1} (80). Although B_{s-1} is reported to have a high incidence of lethal sectoring, most of the lysis of the cell must be due to induction, since a high efficiency of phage induction was observed at the uv dose used. (BBB)

51526 DARK REPAIR OF PHOTOREPAIRABLE UV LESIONS IN ESCHERICHIA COLI. **Harm, Walter (Southwest Center for Advanced Studies, Dallas). Mutat. Res., 6: 25-35(July-Aug. 1968).**

Photoenzymatic repair (PER) immediately after uv irradiation of E. coli B/r abolishes approximately 67% of those uv lesions that usually do not become dark repaired (PR sector = 0.67). If the irradiated cells are held in buffer before undergoing PER, the PR sector decreases and becomes virtually zero after 24–48 hr holding. Such an effect is essentially absent in the E. coli strains B_{s-1}, AB 2437, and AB 2480, which are deficient in excision–resynthesis dark repair (ERR). In B/r, the decrease in the PR sector is much inhibited in the presence of potassium cyanide, caffeine, and acriflavine. These and other results suggest that the observed loss of photoreactivability by holding in buffer is due to excision of photorepairable lesions. However, the fact that

the decrease in PR sector is the result not only of an increase in dark survival ("liquid-holding recovery"), but also of a decrease in the absolute level of PR survival indicates that excision does not always lead to dark repair. Loss of photoreactivability during holding is only partial in strain AB 2463 (rec⁻), which is deficient in another type of dark repair ("REC repair"), and in E. coli B. No PR is observed in B/r cells uv-irradiated at an extremely low dose-rate (where they are known to undergo most extensive dark repair), while under the same conditions a reduced amount of PR is still found in AB 2463 (rec⁻) cells. Altogether, the results indicate that (1) in E. coli B/r under usual irradiation conditions PER repairs preferentially uv lesions that would otherwise be dark-repaired; (2) in fact, all of the photo-repairable lesions in E. coli are dark-repairable; and (3) complete dark repair of photo-repairable lesions in B/r requires both REC repair and a higher-than-normal extent of ERR. (auth)

51527 DEFECTIVE PHAGE FORMATION BY LYSOGENS OF INTEGRATION DEFICIENT PHAGE P22 MUTANTS. **Smith, Hamilton O. (Johns Hopkins Univ., Baltimore).** Virology, 34: 203-23 (Feb, 1968).

Integration deficient (L) mutants of phage P22 can be complemented with L^+ phage to yield L mutant lysogens. Once established the L prophage is stable in the absence of L^+ function. Ultraviolet irradiation or thermal induction of L lysogens leads to production of defective phage particles and low yields of infectious phage. The defective particles contain a normal amount of DNA but the DNA is mainly bacterial in origin and appears to derive from the pro C region adjacent to one end of the prophage. The defective lysates transduce pro C at high frequency relative to other bacterial markers. The representation of phage genes is strongly polar with markers distal to pro C being rarely present. It appears that L^+ function is required not only for efficient integration of the prophage, but for normal recovery of the prophage genome following induction. (BBB)

51528 CYTOLOGICAL DIFFERENCES BETWEEN CONTINUOUSLY AND INTERMITTENTLY ADMINISTERED X IRRADIATION OF PLANT SUBSTANCE AND THEIR PRESUMPTIVE SIGNIFICANCE FROM THE VIEWPOINT OF ANTICATHODAL METALS. IN REPLY TO D. E. LEA. **Komuro, Hideo (Kyoto Women's Coll., Japan).** Cytologia (Tokyo), 31: 392-401 (1966). (In German).

Effects of continuous and intermittent x irradiation on root tip cells of Vicia faba seedlings were compared using Mo or W anticathodes. The physiological and cytological effects of irradiation were generally more pronounced and appeared sooner when Mo was used and the x irradiation was given intermittently, as compared to continuous irradiation with a W anticathode. The general cytological differences observed included variations in staining properties, abnormalities in the walls of the nucleus, alterations of the mitotic phases, chromosome breaks, multinucleated cells, abnormal nuclei, tripolar nuclear division, hypochromatism, hyperchromatism, karolysis and pyknosis, irradiation damage of the periblem and plerom, vacuolization of the nuclei and cytoplasm, and alterations of the chromosomes and karyotin. (BBB)

51529 EVIDENCE FOR MULTIPLICITY REACTIVATION OF ULTRAVIOLET LIGHT-IRRADIATED RIBONUCLEIC ACID ISOLATED FROM TOBACCO MOSAIC VIRUS. **Takahashi, Tsuyoshi; Hayashi, Takaharu; Kiho, Yukio (Inst. for Plant Virus Research, Chiba, Japan).** Jap. J. Microbiol., 12: 187-93 (June 1968).

Multiplicity reactivation (MR) was found to take place in leaves of Nicotiana glutinosa inoculated with uv-irradiated RNA from tobacco mosaic virus (TMV-RNA). This was not observed with uv-irradiated TMV particles. Considering MR as resulting from genetic recombination between viral genomes, a recombination mechanism, which has been difficult to prove with plant viruses, is proposed as being operative during multiplication of TMV. From the pattern of MR of TMV-RNA, the location of the gene for the RNA replicase within a TMV-RNA strand is discussed. Four possible reasons why MR does not occur with uv-irradiated TMV particles are also discussed: uv-inactivated TMV cannot enter a susceptible cell; owing to the strong exclusion phenomenon, only one virus particle can enter a susceptible leaf cell; uncoating of uv-irradiated TMV may not readily occur; and intact TMV receives uv damage that is incapable of MR. (BBB)

51530 LOCI OF RADIATION SENSITIVITY IN Bs STRAINS OF ESCHERICHIA COLI. **Donch, John; Greenberg, Joseph (Palo Alto Medical Research Foundation, Calif.).** Genet. Res., 11: 183-91 (Apr, 1968).

Some mutants (Bs) more sensitive to uv irradiation than the parent strain B were studied and the genes responsible for uv sensitivity in ten sensitive mutants were mapped by transduction. The uvr genes of all the mutants able to reactivate uv-irradiated phage (HCR^+), including Bs2, 4, 5, 6, 7, 9, and 10, were linked, 50 to 95%, with malB. The gene of Bs12 (HCR) was also linked to malB as is uvrA. The gene of Bs8 (HCR) was linked to gal, that of Bs3 (HCR) to his. Transduction of mal^+ from a strain with uvrA, or a mal^+ derivative of Bs12, to Bs2, 4, 5, 6, 7, 9, or 10, yielded about 30% uv-resistant transductants. A mal^+ transduction with Bs2 mal^+ as donor and other Bs strains as recipients yielded < 0.1% uv-resistant transductants. The malB-linked uvr genes of all mutants (except Bs3 and Bs8) were transducible with metA. The quasi-reciprocal crosses and 3-point tests suggested the order of markers as metA malB uvr (HCR^+) uvr (HCR). The sensitivity gene of Bs9 was exceptional in that it appeared to lie between metA and malB. (BBB)

51531 CLUSTERS OF ABERRANT SCALES AFTER X IRRADIATION OF THE WING ANLAGEN IN FEMALE DIAPAUSE AND NONDIAPAUSE CATERPILLARS OF PLODIA (LEPIDOPTERA). **Pentz, Siegwald; Krause, Gerhard (Heiligenberg-Institut fuer Experimentelle Biologie, Germany).** Arch. Entwicklungsmech. Organ., 160: 167-86 (Mar. 14, 1968). (In German).

In diapausing last-instar caterpillars (reared at 20°C) of the Indian meal moth Plodia interpunctella, all nuclei of the posterior wing anlagen (about 2700 cells each) are in the prophase stage. In nondiapausing larvae (30°C), on the other hand, a considerable variety of mitotic stages can be observed. When female caterpillars were x-irradiated with 4000 R in the 2700-cell stage, clusters of aberrant scales were found on the wing of the imago. The appearance of scales varied within one cluster. Ten different somatic mutants were distinguishable on the upper side of the posterior wing. Their differences in shape, color, and pattern of the ribs are described. The two most frequent somatic mutants, PS 1 (808 mutations in all) and PS 3 (184 mutations) were evaluated quantitatively: In irradiated wings the ratio of PS 1 clusters of diapause vs nondiapause wings (100 : 57) was similar to the corresponding ratio of prophase stages (100 : 56). For PS 3, the cluster ratio was 100 : 87. In unirradiated wings, clusters of both mutants were rare. There were no differences of the frequencies of solitary mutant scales between irradiated and unirradiated wings. Whether the mutations were induced in a nondiapausing wing anlagen during the prophase stages only was discussed. (BBB)

51532 CELLULAR LOCATION OF THE GENES CONTROLLING PENICILLINASE PRODUCTION AND RESISTANCE TO STREPTOMYCIN AND TETRACYCLINE IN A STRAIN OF STAPHYLOCOCCUS AUREUS. **Poston, Susan M. (Guy's Hospital Medical School, London).** Nature (London), 210: 802-4 (May 21, 1966).

Ultraviolet irradiation of transducing phage enhances transduction of some staphylococcal markers including streptomycin resistance. Kinetic development of phenotypic expression and the effect of uv irradiation on the frequency of transduction were used as criteria to judge the location of markers responsible for high-level resistance to streptomycin, resistance to tetracycline, and production of penicillinase. All recipient and donor strains were derivatives of a penicillinase-producing strain of S. aureus S26 P^+, lysogenized with phage 53. Donor phage was obtained by uv induction of a streptomycin-resistant, tetracycline-resistant mutant of S26 P^+. Ultraviolet-irradiated transducing phase was obtained by exposing 5-ml amounts of undiluted phage to a source of uv light emitting 5.4×10^4 erg/cm^2/min. Different patterns of phenotypic expression were shown by the markers studied. Streptomycin-resistant transductants exhibited a typical phenotypic expression lag. The penicillinase marker showed no lag in phenotypic expression but the number of transductants failed to increase over the next 3 hr although the recipient itself multiplied exponentially in the same period. These findings probably reflect segregation of a dominant gene. In tetracycline-resistant transductants, both phenotypic lag and segregation lag were absent and the transductants grew at a rate similar to that of the recipient culture. The absence of any lag was explained by the replication of the gene immediately on entering the cell, before the onset of cell division, so that all progeny received the determinant controlling tetracycline resistance. The frequency of transduction of streptomycin resistance and penicillinase production after 6 min of uv treatment of the phage was increased by a factor of 69 and 14, respectively, at a phage inactivation level greater than 90%. However, the frequency of tetracycline transductants showed no increase but fell with increasing doses of uv irradiation. These results support the chromosomal location of the genes for streptomycin resistance and penicillinase production. (BBB)

51533 COMPARATIVE STUDY ON CHROMOSOME ABERRATIONS IN PERIPHERAL LEUCOCYTES INDUCED BY VARIOUS ANTICANCER DRUGS AND IONIZING RADIATION. **Kawasaki, Mitsuo; Tojo, Shimpei; Nishimura, Toshio; Sugahara, Tsutomu (Kyoto Univ., Japan).** J. Jap. Obstet. Gynecol. Soc. (Engl. Ed.), 14: 137-45 (July 1967).

Blood leucocyte cultures were made from patients with malignant

diseases who were treated with Toyomycin, Methotrexate, and γ radiation. Chromosomal aberrations after Toyomycin therapy were seen as gaps, breaks, acentric fragments, ring chromosomes, dicentric chromosomes, and somatic pairing. After intravenous and oral Methotrexate therapy, abnormal chromosomes revealed gaps, breaks, acentric fragments, long ring, and dicentric forms. When Methotrexate was administrated intramuscularly, the only aberrations were acentric fragments and union of chromosomes. One patient was injected with Endoxan and Leucomycin and irradiated with ^{60}Co γ rays (6000 to 8000 R) one yr earlier. Later she was treated with Toyomycin. Cytologic studies revealed somatic pairing (chromosomal exchange), dicentric chromosomes, ring chromosomes, and acentric fragments. Mitoses could not be observed by the technique of peripheral blood cell culture used immediately after high doses of radiation, but after chemotherapy mitoses could be readily observed. This may be the result of the differential effect of the two kinds of agents on the proliferation of lymphocytes. Differential patterns of chromosome aberrations induced by antitumor agents and radiation are described. Methotrexate resembled ionizing radiation in its effects. Toyomycin induced the most wide variety of aberrations among the agents studied so far. After radiotherapy abnormal chromosomes may persist for years, the incidence decreasing gradually after irradiation, but after chemotherapy it was found that eight to 10 days later chromosomal aberrations induced by the drugs had disappeared. (BBB)

51534 REPAIR-MECHANISMS AND RADIATION-INDUCED MUTATIONS IN FISSION YEAST. Nasim, Anwar (Chalk River Nuclear Labs., Ont.). Genetics, 59: 327-33(July 1968).

The influence of repair mechanisms on mutation induction by uv irradiation was studied in fission yeast. A normal adenine-requiring red strain and three uv sensitive strains of independent origin were used. The relative frequencies of mosaic and complete mutants were compared in these four strains to test the repair-hypothesis for the production of pure clones. The two slightly sensitive strains uvr$^-$ N_1 and uvr$^-$ N_2 showed a much higher proportion of mosaic mutants and also a higher total mutation frequency as compared with the normal strain. These findings agree with the predictions from the repair-hypothesis for the production of pure mutant clones. A third highly sensitive strain did not conform to the predictions of the repair-hypothesis. In this strain increased killing was accompanied by a marked decrease in the overall mutation frequency per survivors. This points to the existence of more than one mechanism which may influence killing and mutation differentially. The implications of these findings are discussed as they relate to the different molecular mechanisms proposed for the production of pure mutant clones. (auth)

51535 MUTAGENESIS IN VULGARE WHEAT. Mac Key, James (Agricultural Coll. of Sweden, Uppsala). Hereditas, 59: 505-17(1968).

Seven different mutagens were applied to dry seeds of the same hexaploid wheat variety, Triticum aestivum ssp. vulgare MK cv. Svalof Rival. Two mutagens were physical agents known to break chromosomes easily, namely neutrons applied from the heavy-water natural U reactor Stockholm R^1 with a slightly moderated fission spectrum (80% fast and 20% thermal neutrons), and x rays. The other five mutagens were chemicals of the alkylating type. The genic reduplication associated with polyploidy gave T. vulgare a visible mutation spectrum very different from the characteristic of diploids. Chromosome mutations that are lethal at a diploid level dominated. The extreme efficiency of some alkylating compounds, known predominantly to induce point mutations and detected in research work with diploids, did not reveal a similar superiority in the 6x wheat. Here, neutrons with their great ability to break chromosomes gave the highest frequency of visible off-types. This does, however, not prove their superior evolutionary influence over the most efficient alkylating compounds. The two types of mutagens seemed to complete rather than to compete with each other in wheat mutation breeding. (BBB)

51536 YELLOW SEEDED MUTATIONS IN BRASSICA JUNCEA HOOK. f. AND THOMS. INDUCED BY RADIOACTIVE SULPHUR-^{35}S. Nayar, G. G. (Bose Inst., Calcutta). Curr. Sci. (India), 37: 412-13(July 20, 1968).

Seeds of Brassica juncea were treated with solutions containing varying amounts of ^{35}S for varying durations of time. Controls were treated with distilled water. The seeds were sown and the plants that were harvested yielded brown seeds. Some of the second and third generation plants yielded yellow seeds. The seeds were poorly developed and shrunken. (H.L.W.)

51537 EFFECTS OF SMALL INCREMENTS OF GENETIC VARIABILITY IN INBRED POPULATIONS OF DROSOPHILA MELANOGASTER. van Delden, W.; Beardmore, J. A. (Univ. of Groningen, Haren, Netherlands). Mutat. Res., 6: 117-27 (July-Aug. 1968).

In laboratory populations of Drosophila melanogaster founded from lines long inbred by brother-sister mating, estimates of changes in genetic variability and population fitness are being made. As part of this study the changes in such parameters induced by small increments of heterozygosity arising from x irradiation, or from a closely related population, added early in the life of populations have been examined. The results show (1) A striking positive and apparently linear correlation between genetic variability (as estimated by heritability determinations of sternopleural bristle number) and fitness as determined by productivity. (2) A definite, though probably transient, positive effect on fitness of very small additions to the populations both of radiation induced heterozygosity and of "natural" heterozygosity derived from a related but less inbred population. (3) The initially worst populations benefit more from the added "natural" heterozygosity than that induced by radiation, while in the initially better populations the reverse is true. (auth)

51538 INFLUENCE OF ANALOGS OF XANTHINE ON THE MUTAGENIC EFFECT OF ULTRAVIOLET LIGHT. Sideropoulos, Aris S.; Lumb, Judith Rae; Shankel, Delbert M. (Univ. of Kansas, Lawrence). Mol. Gen. Genet., 102: 102-7(Aug. 5, 1968).

Eight compounds can be added to those purine analogs which give synergistic effects with ultraviolet light: 1,3,7,9-tetramethylxanthine methyl sulfate, 8-chlorocaffeine, ethyltheophylline, 6-dimethylaminopurine, 6-methoxypurine, 8-ethoxycaffeine, 1,3-dimethyl uric acid and 3-methyl uric acid. It appears likely that these are merely representatives of the class of methyl purines, and that other compounds are also active. The synergistic activity varies among the compounds investigated; some give a synergistic effect slightly higher than caffeine, but apparently act by the same mechanism. The height of effect of all the synergistic purine analogs was correlated with the stability of the structures determined by inductive effects and steric hindrance. The lack of activity with pyrimidines (1-methyl thymine and 1,3-dimethyluracil) led to conclusion that both rings (7,8,9 positions) of the purine molecule were necessary for the synergistic effect. A radiation resistant strain of Escherichia coli was used. (auth)

51539 ABSENCE OF REPAIR OF PHOTODYNAMICALLY INDUCED DAMAGE IN TWO MUTANTS OF PROTEUS MIRABILIS WITH INCREASED SENSITIVITY TO MONOFUNCTIONAL ALKYLATING AGENTS. Boehme, H. (Research Inst. of Cultivated Plants, Gatersleben, Ger.). Mutat. Res., 6: 166-8(July-Aug. 1968).

Two ultraviolet-sensitive mutants of Proteus mirabilis are described that are more sensitive to inactivation by ethyl methanesulfonate than wild-type. These two mutants were also more sensitive to photodynamic inactivation than wild-type. The results suggested the possibility that damage induced either by monofunctional alkylating agents or by photodynamic treatment was normally repaired by the same mechanism. (M.M.B.)

51540 MUTAGENIC EFFECT OF THE IRRADIATED ENDOSPERM IN WATER-SOAKED SEEDS OF DURUM WHEAT. Meletti, P.; Floris, C.; d'Amato, F. (Univ., Pisa, Italy). Mutat. Res., 6: 169-72(July-Aug. 1968).

Embryo transplantation experiments are reported that were designed to assess the conditions under which x irradiation of water-soaked seeds conferred mutagenic ability on the endosperm. Chlorophyll mutations were used that occurred in durum wheat with good frequency and with a wide range of types after mutagenic treatment. The frequency of mutations in the progeny of unirradiated embryos transplanted into irradiated endosperms are reported, and the effects of radiation dose are considered. (M.M.B.)

51541 RECOVERY OF UV-INACTIVATED E. COLI CELLS BY THE v-GENE ACTION OF PHAGE T4. Harm, Walter (Southwest Center for Advanced Studies, Dallas). Mutat. Res., 6: 175-9(July-Aug. 1968).

Experiments are reported which show that survival of uv-irradiated Escherichia coli (hcr-) can be increased upon infection with irradiated T_4 v^+ bacteriophage (which controls an excision repair system) in contrast to infection with irradiated T_4 v^- phage (which does not control a repair system). The efficiency of v-gene action for repair of E. coli DNA appeared to be as high for the bacterial DNA as for repair of T_4 phage DNA. (M.M.B.)

51542 THE ISOLATION, GENETICS, AND SURVIVAL CHARACTERISTICS OF ULTRAVIOLET LIGHT-SENSITIVE MUTANTS IN YEAST. Cox, B. S.; Parry, J. M. (Botany School, Oxford). Mutat. Res., 6: 37-55(July-Aug. 1968).

Ninety-six mutants of yeast were isolated that were more sensitive than wild-type to uv irradiation. Genetic analysis showed that

many were inherited as single mendelian recessive mutations and that they occupied at least 22 different loci. Survival curves showed that in all the mutants the low uv-dose shoulder characteristic of the survival curve of wild-type yeast was absent or very reduced, but that the slopes varied from one mutant to the next and were often complex. Five mutants were also more sensitive to ionizing radiation than wild-type and five reduced the ability of yeast to sporulate. (auth)

51543 THE EFFECT OF SULFAGUANIDINE IN Co-γ-IRRADIATED G_1 AND G_2 CELLS ON THE INCOMPLETENESS OF EXCHANGES AND THE QUESTION OF GAPS IN VICIA FABA L. Lazanyi, A. (Centre of Biological Researches, Cluj). Mutat. Res., 6: 67-79(July-Aug. 1968).

The BR index (i.e., the ratio of the number of fragments to the number of reunions) showed that the aberrations induced by Co-γ-rays in G_2 cells were to a large extent, incomplete, while the majority of those induced in G_1 cells were complete. Under the influence of sulfaguanidine, the frequency of incompleteness in chromatid-type aberrations was reduced to half, but that of chromosome aberrations remained unaltered. The halving of the frequency of incomplete metaphase aberrations in G_2 paralleled the doubling of the number of anaphase bridges. The gaps at the sites of exchange were proved to be real discontinuities. The anaphase-frequency curve in G_2 showed that almost all gaps released their fragments. The cause of the cohesion at the gaps is discussed. (auth)

51544 EXPERIMENTS ON THE MECHANISMS OF X-RAY INDUCED CHROMOSOME LOSS. Traut, H. (Univ. of Muenster, Ger.). Mutat. Res., 6: 109-15(July-Aug. 1968).

The influence of dose fractionation and dose protraction on the induction of X-chromosome loss (leading to viable XO males) after irradiation of mature (stage 14) and immature (stage 7) oocytes of Drosophila melanogaster has been investigated. 150 kV x rays were used with a dose rate of 850 R/min or —in the protracted treatments —100 R/min and 50 R/min. In the fractionation experiments the doses were halved and separated by irradiation-free intervals of 20 min or 60 min. Fractionation and protraction of the dose decreases the x loss frequency when immature, but not when mature oocytes are irradiated. This finding fits the (almost) linear relationship between X-loss frequency and x ray dose when mature oocytes are irradiated, and the multi-hit curve obtained after treatment of immature oocytes. From the close parallel existing between the radiation response (as regards stage sensitivity, dose dependence and dose-rate dependence) of X-chromosome loss and dominant lethality, common principal causes of these two radiation effects are postulated: on the basis of the experimental data so far available, single chromatid breakage after irradiation of mature oocytes and sister-chromatid breakage after irradiation of immature oocytes are considered as the main mechanisms of both X-chromosome loss and dominant lethality. (auth)

51545 MEASUREMENTS OF X-RAY INDUCED MUTATIONAL DAMAGE IN STAGE-14 OOCYTES OF DROSOPHILA. Zimmering, S.; Scott, J. (Brown Univ., Providence). Mutat. Res., 6: 179-80(July-Aug. 1968).

Four-day-old Drosophila melanogaster females were x-irradiated. The frequencies of chromosome aberration in eggs laid in different time periods after irradiation were measured. The results suggested that the frequencies of induced detachment of attached-x's, deletions, and sex-chromosome loss and non-disjunction among progeny derived from eggs laid the first 6 hr following irradiation were some two to four times higher than those based on offspring derived from eggs laid over the 24 hr period. (M.M.B.)

51546 SOME DISPUTED QUESTIONS IN THE PROBLEM OF POSTRADIATION RECOVERY OF THE CHROMOSOMES. Luchnik, N. V. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 408-17(1968). (In Russian).

The term recovery is applied by different authors to different concepts. In this article, it is used to denote nonrealization of latent damages, a consideration of which here is limited to the cytogenetic level. Evidences cited against the idea that the formation of observable chromosome aberrations is based upon true breaks. Most of the facts support the correctness of the template theory. The impossibility, without making more or less arbitrary assumptions, of determining the rate of recovery and time of realization using existing facilities was demonstrated. The results of experiments indicating that cellular and local recovery involves processes that occur at the presynthetic and synthetic stages of the cellular cycle, respectively, were analyzed. Possible molecular mechanisms of both types of recovery are discussed. (JPRS)

51547 CHLOROPHYLL MUTATIONS AFTER LOW DOSES OF CHRONIC IRRADIATION OF BARLEY. Horcariv, R.; Danko, V.; Kovac, L. (Faculty of Natural Sciences, Kosice, Czech.). Biol. Plant., Acad. Sci. Bohemoslov., 10: 127-30 (1968).

Chlorophyll mutations were evaluated in barley, Hordeum sativum var. Valticky, by examining the progeny of plants irradiated at a dose rate of 0.004 to 16.8 R/day in a γ field. The total chlorophyll mutation frequency increased immediately after exposure to a dose rate of 4 mR/day. A dose rate of 0.029 to 1.00 R/day yielded a slight increase of the chlorophyll mutation frequency, and a greater increase occurred at dose rates of 1.00 to 16.80 R/day. Changes in the mutation spectrum are described. A gradual decrease of the frequency of some mutation types with dose rate was seen. This may have been caused by the lethality of this mutation at higher dose rates. The variation in the frequency of some mutations was so high that it was impossible to detect significant changes in relation to the daily dose. This is explained by the fact that irradiation within the given intensity did not affect the frequency of these mutations. (TSS)

51548 INDUCTION OF ECERIFERUM MUTANTS IN BARLEY BY IONIZING RADIATIONS AND CHEMICAL MUTAGENS. II. Lundqvist, U.; Von Wettstein-Knowles, P.; Von Wettstein, D. (Univ. of Copenhagen). Hereditas, 59: 473-504(1968).

Distribution of 380 induced and four spontaneous eceriferum (cer) mutants belonging to 44 loci was analyzed. The mutants induced by sparsely ionizing radiations and by ethylenimine were distributed evenly among the loci. Pronounced cer locus specificities were found if densely ionizing radiations and sulfonates were used as mutagens. Neutrons acted preferentially on locus i, whereas the sulfonates mutated preferentially the loci u, q and c. The mutant cer-j^{58} with glossy leaves had on its leaf blades 20% less ether-extractable wax than the wild type. The mutant was contained very little of the long-chain primary alcohols, a major constituent of the leaf wax. This resulted in a drastically changed morphology of the wax crystals. From the bright green leaf sheaths of the mutant cer-c^{36}, 70% less wax was extracted than from the wild type. The mutant wax lacked almost entirely the long-chain ketones, the predominant component of the wild type's long wax needles. These needles are absent from the cuticle of the leaf sheaths on the mutant. (BBB)

51549 CARYOTYPIC ANALYSIS IN FOUR CASES OF ACCIDENTAL IRRADIATION. Lejeune, J.; Berger, R.; Levy, C. (Hopital des Enfants Malades, Paris). Ann. Genet. (Paris), 10: 118-23(Sept. 1967). (In French).

Four cases of accidental irradiation were studied for chromosomal aberrations. In the first case irradiation had been caused by a beam of polarized protons. According to physical reconstruction dosimetry, the maximum dose in neutrons and γ rays was 33 rad. Peripheral blood cultures were made 46 hr, and 31, 135, and 364 days after the accident. The second case received 35 to 50 rad of γ rays and soft x rays. The third and fourth cases had worked under the same conditions as the second, but no dosimetry was possible. Blood for chromosome analysis was taken between $1\frac{1}{2}$ and $2\frac{1}{2}$ months from the time of the accident. The frequency of ring chromosomes and dicentrics was examined in relation to the estimated dose. The relation established by the Bender and Gooch formula agreed with the data. However, difficulties of cytologic interpretation were thought to limit the practical applications of this biological method of dosimetry. The study of mitotic disorders occurring later in cells already carrying a radioinduced chromosome rearrangement was considered important. It was observed that these secondary changes evoked a clonal evolution of the caryotype. It was concluded that systematic analysis of the changes might produce useful indication concerning the mechanism of carcinogenesis in irradiated tissues. (BBB)

51550 ON THE CORRELATIONS BETWEEN MORPHOLOGICAL AND PHYSIOLOGICAL CHANGES IN MUTANTS OF ASPERGILLUS NIGER. Imshenetskii, A. A.; Shcherbakova, E. Ya. (Inst. of Microbiology, Moscow). Microbiology (USSR) (Engl. Transl.), 33: 221-7(Mar.-Apr. 1964).

Conidia of A. niger strains 82 and 90 were uv irradiated at doses of 340, 510, 1020, 2040, and 4080×10^3 erg/cm^2. Cultures (970) grown from irradiated conidia of strain 82 were isolated and 752 cultures were obtained from strain 90 after inoculation with irradiated conidia, and their ability to produce citric acid was investigated. The activity of cultures giving rise to morphologically altered colonies was also studied as well as the activity of cultures which by their exterior appearance could not be distinguished from colonies of the original culture. The capacity for citric acid production was found to vary greatly, some mutants producing less acid than the parent culture and some, among the morphological variants, producing considerably more. In selection of active variants, use could be made of the correlation existing between the morphology of a colony and its ability to produce citric acid. Cultures of degenerate (sublethal) mu-

tants giving rise to dwarfs and aconidial colonies were not of value. The most active cultures found to have practical use were among the morphological variants. (BBB)

51551 CHROMOSOMAL LOCATION OF THE GENETIC ELEMENTS CONTROLLING PENICILLINASE PRODUCTION IN A STRAIN OF STAPHYLOCOCCUS AUREUS. **Asheshov, Elizabeth H. (Cross-Infection Reference Lab., Colindale, London). Nature (London), 210: 804-6(May 21, 1966).**

Evidence for the chromosomal or nonchromosomal location of genes controlling penicillinase production in three strains of S. aureus was obtained from the frequency of transduction of penicillinase formation as of function of uv irradiation of transducing phage. In one strain the genes controlling penicillinase production seemed to be extrachromosomal, in the second to be chromosomal, and in the third to have characteristics of both chromosomal and extrachromosomal elements. The results of transduction experiments with three different phage lysates which had been exposed to various doses of uv irradiation were described. The frequency of transduction was shown as a function of the dose of uv light given to the phage. With the donor strain 8325-18 and the recipient strain 8325, the marker transduced was penicillin resistance. The rate of transduction decreased exponentially with the dose of uv light. When PS 80 T^rT^r was the donor and strain 2/S the recipient, transduction of resistance both to penicillin and to tetracycline was treated. The frequency of transduction of tetracycline resistance decreased exponentially with increasing doses of uv irradiation, but at a slower rate than that observed for penicillin resistance, suggesting that the genes controlling tetracycline resistance were less sensitive to uv light than those controlling penicillin resistance. The transduction of tetracycline resistance was consistent with the hypothesis that this marker was carried on a plasmid. Ultraviolet irradiation increased the frequency of transduction when the transducer marker was chromosomal, but decreased it when the marker was extrachromosomal. The frequency of transduction of extrachromosomal markers was ~100 times higher than for chromosomal markers. Ultraviolet irradiation of the transducing phage could increase the frequency of transduction of chromosomal markers by stimulating recombination. (BBB)

51552 GENETICS AGAINST RADIATION. **Doubinine, N. (Biophysics Inst., Moscow). Agriculture (Paris), 295: 397-8 (Dec, 1966). (In French).**

The problem of cosmic radiation exposure of astronauts was discussed. The similarity between these radiations and man-made radiation from particle accelerators was stressed. Astronauts could wear heavy protective devices, but plants, animals, and microorganisms which accompanied the astronaut could not be protected within practical limits. Two methods of protection were outlined. The first was provided by the walls of the spacecraft. The second method provided for protection within the cell by chemical agents. It was found that bromide, iodide, and certain other ions reduced the effect of radiation. Cysteamine was effective in reducing injuries from radiation. Studies made on serotonin, streptomycin, cysteamine, and other preparations revealed genetic protection to human cells submitted to doses of 50 to 100 R. It was concluded that further research was necessary since protection of cells against genetic effects of radiation had not been sufficiently achieved. (BBB)

51553 TRANSMUTATION EFFECT. **pp 341-2 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.**

When the chromosome of Escherichia coli was labeled with ^{3}H-thymidine, viability losses corresponded to an increasing number of tritium disintegrations, although enzyme formation was not affected. The effect of tritium on the reversion of arginine dependence of E. coli was investigated. Tritium bound mainly to RNA was significantly more effective in yielding reverted mutants among the survivors than was tritium bound to DNA or protein. Transmutation effects are considered expressions of localized molecular reactions insufficient for causing death but capable of inducing mutations; therefore they should become recognizable in cells of higher organisms with proper genetic techniques. (H.L.W.)

51554 PHOTODYNAMIC INDUCTION OF MUTATION AND INACTIVATION IN SERRATIA κ PHAGE BY METHYLENE BLUE AND LIGHT. **Brendel, M.; Kaplan, R. W. (Univ., Frankfurt am Main). Mol. Gen. Genet., 99: 181-90(1967). (In German).**

Induction of mutations and inactivation of Serratia marcescens κ phage by uv irradiation (253.7 nm), or by visible light in the presence of methylene blue, were studied. Extracellular treatment with methylene blue and light (MB + Li) caused inactivation and induction of mutations in the phage. Inactivation was partly due to lesions in the DNA as concluded from marker rescue (CR) experiments where 67% of uv- and 40% of MB + Li-induced damage could be reactivated. About 32% of the lethal lesions after MB + Li could be reactivated by host cell reactivation (HCR), whereas induced mutations were not influenced. Photoreactivation (PR) of lethal damage and mutations was not detected. Postincubation of MB + Li-inactivated free phage in saline or dye solution at 30°C caused additional inactivation but mutations again were not influenced. The three types of plaque type mutations scored (clear = c + 1, narrow = e, and pale = b) were induced by MB + Li according to concave light-dose curves, indicating induction by different average hit numbers (2.3, 1.6, and 3.0). Increase of the fraction of plaque type mutants due to selection was excluded. Increase of the mutant types "g", however, was due to selection only. The proportion of the three mutant types induced by MB + Li was different (at all light doses) from the ones induced by the guanine-specific mutagens ethyl methane sulfonate or low pH; thus, the MB + Li-induced lesions leading to mutations were due to different changes of guanine moieties or did not originate in guanine destruction. (BBB)

51555 TOXICITY OF TRITIUM-LABELED THYMIDINE. **pp 320-38 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.**

Effects of tritium-labeled thymidine on DNA in the nucleus and genetic material of multiplying cells are emphasized. Within the group of radiation effects, besides mitotic delay and lethality, chromosome changes and delayed manifestations such as mutations and tumor inductions are of prevailing interest. Data are presented for effects on microorganisms, insects, plants, and animals. Related information contrasting with ^{3}H-thymidine toxicity or bearing on the problem of genetic damage caused by other tritium-labeled nucleosides and tritium-labeled amino acids is also cited. (H.L.W.)

Health Physics and Safety

Refer also to abstracts 51083, 51240, 51241, 51301, 51303, 51306, 51322, 51386, 51404, 51674, 51675, 51681, 51682, 51687–51694, 51696, 51703, 51740, 51743, 51746, 51778, 51787, 51799, 51810, 51811, 51862, 51915, 52015, 52018, 52064, 52068, 52069, 52113, 52121, 53062, 53393, and 53490.

51556 (AECL-3158) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1968. **(Atomic Energy of Canada Ltd., Chalk River (Ontario)). Aug. 1968. 44p. (PR-B-78). Dep. CFSTI. CAN $1.50.**

The progress report of the Biology and Health Physics Division for the period April 1 to June 30, 1968, is presented. Topics include biochemistry and molecular biology, cellular and whole animal physiology, genetics and population studies, environmental research, and health physics. (B.G.D.)

51557 (AED-C-02-08) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 02, KONTAMINATION UND DEKONTAMINATION VON LEBENSMITTEIN. (Bibliographies in Nuclear Science and Technology. Section 02. Contamination and Decontamination of Food). **Schmidt, Hans Dieter; Beising, Kurt (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Apr. 1968. 89p. (In English and German). Dep.**

Approximately 350 references are listed on radioactive contamination and decontamination of foodstuffs. References to methods of measurement and separation are also given. Author and subject indexes are included. (H.L.W.)

51558 (AEET/HP/R-13) EVALUATION OF ACCEPTABLE LIMITS FOR RADIOACTIVE CONTAMINANTS IN THE CHAMBAL RIVER: RANA PRATAP SAGAR. **Pillai, K. C.; Ganapathy, S.; Desai, M. V. M.; Ganguly, A. K. (Atomic Energy Establishment, Trombay (India). Health Physics Div.). 1966. 79p. Dep.**

Maximum permissible concentrations of radionuclides in the aquatic environment of the Chambal river are evaluated. The evaluation takes into account only the exposure to people from the presence of radioactive contaminants in the river from operations in Rajasthan Atomic Power Plant. (B.G.D.)

51559 (AHSB(RP)-R-77) OCCUPATIONAL HYGIENE STANDARDS FOR NATURAL URANIUM. **Spoor, N. L. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch). July 1968. 20p. Dep. CFSTI. UK 3s. 6d.**

The basis of various recommended values for the maximum permissible concentration in air – $(MPC)_a$ – of uranium compounds, between 1944 and 1967, is examined. The enquiry includes an assessment of the different kinds of evidence used, and an evaluation of the contributions from the organizations principally involved. (INIS) (UK)

51560 (BNWL–706) CRITERIA USED TO ESTIMATE RADIATION DOSES RECEIVED BY PERSONS LIVING IN THE VICINITY OF HANFORD: INTERIM REPORT. Wilson, R. H.; Essig, T. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1968. Contract AT(45-1)-1830. 17p. Dep. CFSTI.

Rationale for dietary habits used in computation of radiation doses during 1964 for selected population groups in the vicinity of Hanford is presented. Also discussed is the method used to compute environmental radiation doses based on these dietary habits and on measured concentrations of radionuclides in several environmental media. (auth)

51561 (BNWL–811) EXDOSE: A COMPUTER PROGRAM FOR CALCULATING THE EXTERNAL GAMMA DOSE FROM AIRBORNE FISSION PRODUCTS. Hendrickson, M. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 124p. Dep. CFSTI.

The EXDOSE program calculates the external γ radiation dose to the whole-body of man from a half-infinite cloud of fission products. It is designed primarily for estimating accident consequences. The code calculates a fission product inventory according to specified input parameters. Any fraction of these fission products may then be released to the atmosphere at a desired rate. The subsequent downwind dispersion and resulting dose to individuals is then calculated. (auth)

51562 (BNWL-SA–1510) TOWARDS INTERIM ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR ENVIRONMENTAL PuO_2. Kathren, Ronald L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 14, 1968. Contract AT(45-1)-1830. 16p. Dep. CFSTI.

The physical and biological factors pertinent to the establishment of acceptable surface contamination levels for environmental $^{239}PuO_2$ are discussed. The actual field measurements of these levels are omitted as well as discussion of the economic, social, psychological, moral, and other intangible factors. A brief analysis from a serious accident involving the release of ^{239}Pu is presented. (B.G.D.)

51563 (CEA-R–3361) NATURAL URANIUM TOXICOLOGY: EVALUATION OF INTERNAL CONTAMINATION IN MAN. Chalabreysse, Jacques (Commissariat a l'Energie Atomique, Pierrelatte (France)). Mar. 1968. 160p. (In French). Dep.

The physical and chemical properties of natural uranium that might affect its toxicology are reviewed. Occupational exposure standards for this particular poison and knowledge of its metabolism and toxicology were applied to accident reports and related literature on human experience. A series of formulae were then obtained by theoretical mathematical development giving principles for internal contamination monitoring and detection by determining uranium in the urine of occupationally exposed individuals. The proposed formula allows a preliminary approach and a quick determination of contamination. Systematical urinalysis results are compared with individual radiotoxicology monitoring professional standards. (C.O.)

51564 (CEA-R–3519) NEW METHOD FOR STUDYING THE EFFICIENCY OF CHELATING AGENTS OF THE POLYAMINE ACID SERIES FOR INTERNAL DECONTAMINATION. Lafuma, Jacques; Nenot, Jean-Claude; Morin, Michele (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). June 1968. 21p. (In French). (EUR–3864). Dep.

We followed the biological fate of a complex formed on one side with either a rare earth (^{144}Ce) or a transuranium element (^{239}Pu), and on the other side with a chelating agent of the polyamino acid series. This method allowed study of the in vivo stability of the various complexes and their comparison; the stability of the complexes as a function of the isotope-chelating agent weight relatio.. ships; and the metabolism of the chelating agents resulting in stable complexes, i.e. DTPA and TTHA. This simple method brought out the higher efficiency of DTPA in chelating rare earths and plutonium and for therapeutic purposes. (auth)

51565 (FOA–4-4322) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. V. UPTAKE BY PASTURE AND LEY PLANTS OF ^{90}Sr AND ^{137}Cs IN SWEDISH FIELD EXPERIMENTS. Fredriksson, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). July 1963. 16p. Dep.

Absorption of ^{90}Sr and ^{137}Cs by pasture plants has been studied in field experiments. The fission products were applied to two different types of grazing land by spraying in early spring before the vegetation had started growing. The influence of different lime and fertilizer treatments on plant absorption of the radionuclides was also studied. (auth)

51566 (IDO–12067) CALCULATION OF ORGAN AND TISSUE BURDENS AND DOSES RESULTING FROM AN ACUTE EXPOSURE TO A RADIOACTIVE AEROSOL USING THE ICRP TASK GROUP REPORT ON THE HUMAN RESPIRATORY TRACT. Voilleque, P. G. (Idaho Operations Office (AEC), Idaho Falls. Health Services Lab.). Aug. 1968. 44p. Dep. CFSTI.

The report of the Task Group on Lung Dynamics for Committee II of the International Commission on Radiological Protection (ICRP) is used as the basis for the derivation of equations for the calculation of organ and tissue burdens and radiation doses resulting from an acute inhalation exposure to a radioactive aerosol. Equations for the doses to sections of the gastrointestinal (GI) tract are derived for the variable daily input to the GI tract following an acute inhalation exposure. These latter equations are based on the approach of Dolphin and Eve for the dosimetry of Eve's new GI tract model. The derived equations are used to calculate the organ and tissue doses resulting from an acute exposure to $^{239}PuO_2$ as a function of time after exposure. A FORTRAN-63 computer program written to simplify the application of the derived equations is appended. (auth)

51567 (IN–1205) HEALTH AND SAFETY BRANCH PROGRESS REPORT [FOR 1967]. McCaslin, J. W. (Idaho Nuclear Corp., Idaho Falls). Aug. 1968. Contract AT(10-1)-1230. 42p. Dep. CFSTI.

KRYPTON-85 — radiation dose to atmosphere from, in vicinity of nuclear fuel processing plants, computer calculation of β and γ
COMPUTER PROGRAMS — ARADS, FORTRAN IV for IBM-1401/7040 for radiological atmospheric dispersion studies
COMPUTER PROGRAMS — RADS, FORTRAN IV for IBM-1401/7040 for radiological atmospheric dispersion studies
IRRADIATION FACILITIES — design of ARVFS field test γ-, using spent MTR fuel elements as sources
TANTALUM-183 — metabolism in man following inhalation in small tantalum oxide particles
METALS — radiation decontamination of, use of foam spray for
RADIATION DOSIMETERS, PERSONNEL — testing of calibration of, design of facility for
PROTECTIVE CLOTHING — use of disposable plastic suits and hoods with positive air supply as
RADIATION DETECTORS — efficiency of Geiger-Mueller and scintillation, for monitoring air
IODINE-131 — diffusion of gaseous, through protective clothing and rubber sheets, measurements of
URANIUM — pyrophoric, packaging and shipping of chipped and powdered
RADIOACTIVE WASTE — treatment of low-level aqueous, in sewage plants, methods for (E.R.B.)

51568 (K–1752) EXREM AND INREM COMPUTER CODES FOR ESTIMATING RADIATION DOSES TO POPULATIONS FROM CONSTRUCTION OF A SEA-LEVEL CANAL WITH NUCLEAR EXPLOSIVES. Turner, Wm. Doyle (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center); Kaye, S. V.; Rohwer, P. S. (Oak Ridge National Lab., Tenn.). Sept. 16, 1968. Contract W-7405-eng-26. 194p. Dep. CFSTI.

EXREM is a computer code to estimate the dose equivalent rate and the total dose equivalent from both β- and γ radiation resulting from submersion in contaminated water, submersion in contaminated air, and exposure to a contaminated surface. There can be more than one environmental release, and exposure can begin at any time after the first release. INREM is a computer code to estimate the cumulative dose equivalent to body organs resulting from a continuous intake. The organ parameters are dependent on the age of the individual, and the intake is a function of post-detonation time and the individual's age. Although the codes were specifically written to estimate doses to populations from construction of a sea-level canal, they may be useful in other dose-estimation studies involving releases of radioactive materials to the environment. (auth)

51569 (LA–3895) RADIATION MEASUREMENTS OF THE EFFLUENT FROM THE NRX-A6 REACTOR. Fultyn, Robert V. (Los Alamos Scientific Lab., N. Mex.). Feb. 8, 1968. Contract W-7405-eng-36. 21p. Dep. CFSTI.

The results of studies on the effluent from the NRX-A6 EP IIIA test are presented, including work performed with large particles. Doses due to cloud passage as determined by several methods of measurement are compared. Sampling and analysis procedures and equipment are also described. (auth)

51570 (NP–17401) ENVIRONMENTAL RADIATION SURVEILLANCE. Public Health Service Publication No. 1224. Nelson, Donald J. Jr.; Snow, Donald L. (Public Health Service, [Washington, D. C.]). [nd]. 11p. GPO.

A brief description is given of the radiological surveillance activities of the National Center for Radiological Health. This section of the Department of Health, Education, and Welfare maintains a nationwide network of surveillance facilities for monitoring ra-

dioactivity levels in air, milk, food, human bone, bovine thyroid, and caribou and reindeer meat in Alaska. In addition to their nationwide surveillance activities, the following radiological safety projects are operated by the department: environmental surveillance around merchant and naval nuclear powered ship sites, surveillance in reactor environs, and off-site monitoring of nuclear device testing and aerospace nuclear activities. (E.R.B.)

51571 (NP-17507) PUBLIC HEALTH CONSIDERATIONS IN MEDICAL DIAGNOSTIC RADIOLOGY (X-RAYS). Report of the Medical X-Ray Advisory Committee. (National Center for Radiological Health, Rockville, Md.). Oct. 1967. 34p. GPO $0.35.

Improvements in the medical use of radioisotopes and radiation are discussed. Exposure of the population to diagnostic x rays is emphasized. The following aspects of medical radiation are considered: present status and potentialities of x-ray diagnostic radiology in the United States; the role of national agencies in its promotion and control; technical means for improvement in equipment, installations, and techniques; the training of personnel; and the importance of the development of human judgment through education and experience. Recommendations are made to the Surgeon General on the proper role of the Public Health Service in promoting the safe and effective use of radiation in medicine and on practical means of carrying it out. (H.L.W.)

51572 (RD/B/N-1143) RELATIVE INHALATION HAZARDS FROM NUCLIDES PRESENT IN FRESH IRRADIATED FUEL. Hilliar, R. A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). July 1968. 8p. Dep.

Tables are presented in which high burnup civil AGR fuel is described in terms of the hazard associated with an aerosol having the same nuclear composition as the fuel. An aerosol of 1 $\mu g/m^3$ is shown to have nearly 7,000 times the MPC for an occupationally exposed worker, but that this hazard is associated with relatively few nuclides, most of which have long half-lives. Since in most situations the relative proportion of the nuclides in a release will be different from that in the fuel itself, the tables are presented in a form that will enable specific differential release data to be incorporated. (INIS) (UK)

51573 (SC-TM-68-436) SANDIA LABORATORY LASER SAFETY STANDARDS. Parker, D. R. (Sandia Corp., Albuquerque, N. Mex.). July 1968. Contract AT(29-1)-789. 26p. (CONF-680911-1). Dep. CFSTI.

From American Industrial Hygiene Association Annual Meeting, Denver, Colo.

The protective measures necessary to set up and operate a laser system safely are covered in this report. Specifications for safety procedures for operating both continuous wave and pulsed lasers are covered. The assigned responsibilities of the using organization, Safety Division, and the Environmental Health Department are also described. (auth)

51574 (UR-49-1000) CHARGE ON LATEX PARTICLES AEROSOLIZED FROM SUSPENSIONS AND THEIR NEUTRALIZATION IN A TRITIUM DE-IONIZER. Soong, An-Liang (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). Sept. 30, 1968. Contract W-7401-eng-49. 52p. Dep. CFSTI.

Thesis.

The charge distribution on insoluble particles produced by atomization of a suspension was measured. The degree to which the charges have been neutralized by passage through a tritium deionizer was determined. (B.G.D.)

51575 ORGAN DOSIMETRY INVESTIGATIONS ON WHOLE-BODY IRRADIATED VIETNAMESE PIGS WITH THE HELP OF LiF RADIATION INDICATORS. Reichel, Gerhard; Schaefer, Roland; Morczek, Adolf; Schmidt, Wolfgang (Medizinische Akademie, Magdeburg, Ger.). Strahlentherapie, 135: 616-22 (May 1968). (In German).

With thermoluminescent dosimeters (LiF), the dose distribution was studied in swine during whole-body irradiation with 200 kV x radiation (0.5 mm Cu, HVL 1.08 mm Cu), in the recumbent and seated position, and for two different weights (m_1 = 15 kg, m_2 = 23 kg). The dose distribution was expressed as a function of the skin dose at the back and as a function of the midline dose. With the applied geometry, the following heterogeneity factors were obtained: 2.5 for m_1 recumbent, 6.2 for m_2 recumbent, and 5.6 for m_2 seated. This proves the rather larger heterogeneity of the dose distributions obtained. Animals of approximately the same weight showed about the same dose in the different organs. (auth)

51576 EVALUATION OF ^{90}Sr CONTENT IN MILK. NOTE II. Romero, E. (Univ., Pavia, Italy). Ann. Sanit. Pubblica, 27: 1347-61(Nov.-Dec. 1966). (In Italian).

The assessment of evaluating ^{90}Sr content in milk is approached by statistical analysis of time series, formed by monthly mean values of ^{90}Sr, ^{137}Cs, Ca, and K content of milk from the central dairies of the province of Pavia. The technique, scarcely known in biometrics, is described and illustrated in detail. The information obtained on statistical relations is compared with that obtained by an earlier multiple regression study applied to individual data. Bunch maps, or graphical representations of interrelations between variables, are illustrated. The final equation obtained is: ^{90}Sr (pCi/l) = 0.1870 ^{137}Cs (pCi/l) + 3.5209 Ca* + 2.9065 K*. This is in substantial agreement with the earlier equation describing the level of activity in which the principal part was also played by an estimating function based on ^{137}Cs. Data are taken for the year April 1964 to March 1965, in which values ranged from 31 pCi ^{90}Sr/l to 13; from 160 pCi/l ^{137}Cs/l to 90; from 1135 mg Ca/l to 1005; and from 1395 mg K/l to 1220. (BBB)

51577 INTRODUCTION ON DEPTH DOSE CURVES AND ISODOSE DISTRIBUTION IN HOMOGENEOUS AND INHOMOGENEOUS MEDIA. Sempert, Max. pp 80-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Depth-dose curves for 5- to 35-MeV electrons in water, isodose curves for 35-MeV electrons in water, and isodose curves for magnetically focused 35-MeV electrons in water are presented and discussed. (W.H.K.)

51578 EFFECT OF ANATOMICAL IRREGULARITIES ON THE DOSE IN ELECTRON BEAM THERAPY. Karjalainen, P.; Brenner, M.; Rytilae, A. (University Central Hospital, Helsinki). Acta Radiol., Ther., Phys., Biol., 7: 129-40(Apr. 1968).

The effect of bone and cavities on the dose distribution of electrons was studied on radiographic film at 15, 20, and 34 MeV. Bone and lead pieces of two different shapes, and a cavity surrounded by polystyrene, were used to simulate anatomical irregularities. The results were compared with similar measurements for cobalt radiation, and the perturbation for electrons was found to be much greater than for cobalt. (auth)

51579 HUMAN RADIUM ASSAY AT NANOCURIE LEVELS USING EXTERNAL COUNTING OF LOW ENERGY PHOTONS. Bengtsson, L. G. (Univ. of Lund, Sweden). Acta Radiol., Ther., Phys., Biol., 7: 148-58(Apr. 1968).

The sensitivity of whole body counting (NaI(Tl)crystal) for assay of small amounts of ^{226}Ra can be increased by special use of the low energy part of the spectrum. For normal subjects the minimum detectable amount of the ^{226}Ra daughter ^{214}Bi can be improved by about a factor of 2. This was verified from measurements of 20 normal subjects, containing besides potassium also 5 to 20 nCi ^{137}Cs, and two subjects containing also 1 to 6 nCi ^{214}Bi (normally equivalent to about 3 to 20 nCi ^{226}Ra). Since the identification obtained from the low energy part of the spectrum is poor, the main use of the method will be for sorting out members of a given group not containing any detectable amounts of radium. (auth)

51580 INFLUENCE OF SCATTERING ON THE DOSE CURVE OF FAST ELECTRONS. Breitling, Gerhard; Vogel, Karl-Heinz. pp 20-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The influence of scattering on the isodose curve of electrons of high energy was examined both in the case of irradiation of homogenous and inhomogenous media. (auth)

51581 THE INVESTIGATION OF OCCUPATIONAL EXPOSURE ON TAIWAN (1961-1966). Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan); Hsu, C. N.; Hsu, P. C.; Tseng, C. L.; Tsai, C. M.; Cheng, C. H. Health Phys., 15: 357-9(Oct. 1968).

A survey is given of the use of the film badge service at the above university, covering hospitals, factories, colleges, experimental stations, etc. Details are given of film calibration and dose evaluation, management of the service, and external and internal exposures. (UK)

51582 RADIOACTIVITY OF FOODS IN 1966. Mitt. Geb. Lebensmittelunters. Hyg., 58: 73-113(1967). (In French).

The radioactive contamination of foods in Europe for 1966 was evaluated and is compared with that for 1965. The ^{90}Sr content of milk averaged 33 pCi/l, or 70% of the 1965 average; the 1964 average had been 67 pCi/l. Using the ^{90}Sr content of milk as a basis, it was estimated that the daily maximum ingestion of ^{90}Sr was 50 pCi for 1966. This figure when compared with suggested values by radiation protection commissions was not found to constitute a hazard for such levels ingested over long periods of time. Mean values were determined for the ^{90}Sr content of cheese,

flour, and bread, and more fragmentary results are presented for other foods. After nuclear explosions in China at the end of 1966, ^{131}I was detected in milk and water, but the level was insignificant. It was noted, however, that such fission products reached Europe an average of two months after each explosion, regardless of distance and magnitude of the tests. Since French explosions were conducted in the southern hemisphere, no research on resulting radioactive breakdown products was undertaken in France. In addition to the research done on radioactive contamination of food, the work of the Communaute de Surveillance is discussed. It was concluded that this organization has contributed considerably to current knowledge in the field. (BBB)

51583 REMOVAL OF RADIOACTIVE STRONTIUM FROM THE BODY WITH SOME CHELATING AGENTS. Kubodera, Akiko (Science Univ. of Tokyo); Mori, Tetsuro; Tsurufuji, Susumu. Yakugaku Zasshi, 87: 511-15 (1967). (In Japanese).

The effectiveness of 10 chelating agents on the excretion of radiostrontium was investigated in mice. Sodium salts and/or mono-Ca Na salts of these chelating agents were used. Preliminary toxicity tests were carried out to estimate their approximate maximum safe doses. The Na salts were generally more toxic and in some instances caused convulsions and occasional deaths which were attributed to the decrease of Ca^2 ion in the blood. The mono-Ca Na salts could be used in 10-fold higher amounts compared with their equivalent Na salts. The chelating agents ^{90}Sr were simultaneously injected into different parts of the body. The animals were killed 24 hr after the injection, and then ashed individually in an electric furnace after removing the digestive tract and bladder. Radioactivity of the ash was assayed to determine the percentage retention of ^{90}Sr in the carcasses. Mono-Ca di-Na salt of bis(dicarboxyaminoethyl) ether was found to be one of the most effective agents tested or about as effective as Ca Na citrate. (BBB)

51584 ^{90}Sr CONTENT OF SOUND AND CARIOUS HUMAN DECIDUOUS TEETH. Rosenthal, H. L.; Austin, Eves, Maura G. (Washington Univ., St. Louis). Arch. Oral Biol., 13: 357-60 (1968).

Carious first and second molar crowns contained significantly greater quantities of ^{90}Sr than comparable sound teeth of St. Louis children born between 1948 and 1953 to 1954 when ^{90}Sr fallout was low. In an attempt to account for this difference, fractionation of dentine and enamel was carried out using samples of sound and carious tooth crowns from incisors, first molars, and second molars that were pooled separately for the first and last 6 months of the birth year. The whole crown, enamel and dentine of sound teeth from children born between 1955 and 1958 contained an average of 14% less ^{90}Sr than comparable fractions of carious teeth. Although this difference was of doubtful statistical significance, the data confirmed previous findings that showed sound whole crowns of first and second molars of children born between 1948 and 1953 to 1954 to contain 34 and 29% less ^{90}Sr, respectively, than carious teeth. The data also showed that enamel consistently contains about 73% of the ^{90}Sr content of comparable dentine. The lower enamel/dentine ratio appeared to be independent of the type of tooth or whether the tooth was sound or carious. Carious material from first and second molars contains consistently higher quantities of ^{90}Sr than comparable whole crowns. The small amount of carious material/tooth crown results in a contribution of only 2.2 and 2.8%, respectively, of the ^{90}Sr found in the entire crown of the tooth. When the data were expressed on the basis of Ca concentration, the contribution was even less. Although the concentration of isotope was significantly lower than that found in the whole crown, the total contribution was low. This finding suggested that only a small error would be incurred by the use of either carious or sound teeth for comparative or public health purposes. (TSS) (BBB)

51585 DISCRIMINATION FACTORS FOR ^{90}Sr AND CONTENT OF ^{137}Cs IN FORAGE CROPS AND IN MILK IN SLOVAKIA IN 1965. Csupka, Stefan; Carach, Jozef (Krajska Hygienicko-Epidemiologicka Stanica, Bratislava). Pol'nohospodarstvo, 13: 281-9 (1967). (In Czech).

Discriminative factors for Sr in daily rations and milk were determined at the Union Co-operative Farm at Jaslovske Bohunice and for hay and milk from different localities in Slovakia. From the discrimination factors it was shown that from the original activity of ^{90}Sr in hay, about 10% on the average was transferred to cow's milk. The activity of ^{90}Sr in the hay and milk in southern parts of Slovakia was lower than in the mountainous areas. It depended mainly on the level of radioactive fallout but the amount of rainfall in 1965 had a decisive influence on the absorption of ^{90}Sr and ^{137}Cs by grass. The average strontium unit values in the milk at Jaslovske Bohunice in 1965 to 1966 were 8.5, in the mountainous regions of Slovakia 13.8, and in the southern regions 4.8 pCi ^{90}Sr/g Ca. Cesium-137, because of its considerably shorter biological half-life, was excreted from the animal more quickly than ^{90}Sr. Due to this lower retention of ^{137}Cs, the ratio of ^{137}Cs/^{90}Sr in milk was 3.1. Thus, about 3 times more ^{137}Cs was transferred to milk than ^{90}Sr based on the total activity in forage crops, though in hay and forage crops this ratio was 1.2 on an average. In cheese made of the cow's milk the strontium unit value was 1.3 times higher as compared with cow's milk and the ratio of ^{137}Cs/^{90}Sr was only 0.2, which meant that ~20% of the activity of ^{137}Cs in milk was transferred to the final product during cheese production. (BBB)

51586 STATE STANDARDS AND BASIC REFERENCE INSTALLATIONS IN THE FIELD OF IONIZING RADIATIONS. Yudin, M. F.; Karavaev, F. M.; Yaritsyna, I. A.; Ruzer, L. S. Meas. Tech. (USSR) (Engl. Transl.), No. 11, 1422-32 (Nov. 1967).

Problems in the development of reference standards on which measurements of ionizing radiations should be based are discussed as well as some problems of transferring unit values from reference standards to reference and working radioactive radiation sources and instruments. Dosimetry of quantized neutron and β radiations is considered. To provide uniform and accurate measurements of quantum radiation exposure doses in the quantum range of 5 to 3000 KeV, 4 reference installations were constructed which reproduce the intensity of an exposure dose in ranges of 5–20, 20–60, 60–250, and 250–3000 KeV. Standard ionization chambers for reproducing the exposure-dose units in the ranges of 5–20, and 20–60 KeV were made of the plane-parallel type, principal dimensions of which are given. By meeting the requirements stated exposure-dose unit in the photon energy range of 5 to 60 KeV with an error of 1 to 1.5% could be reproduced. Reference standard for a neutron radiation dose unit consisted of tissue-equivalent and graphite ionization chambers which are similar in their construction and have a volume of 953 cm^3. The wall thickness of either chamber is ~5 mm. The tissue-equivalent chamber is filled with a tissue-equivalent gas, and the graphite chamber with CO_2 up to a pressure of 0.1 MN/m^2 (760 mm Hg). Neutron radiation absorbed doses in the range of 2 to 10^3 $\mu W/Kg$ could be reproduced with an error of 1 to 5%. A spectrometric method, equipment, and special radiation sources were developed for measuring, with high precision, concentrations of the disintegration products of radon and thoron. (TSS) (BBB)

51587 ^{137}Cs IN AGRICULTURALLY USEFUL PLANTS AND SOILS IN THE TERRITORY OF THE GDR (GERMAN DEMOCRATIC REPUBLIC) 1960–63. Reissig, Herbert (Technische Univ., Dresden). Albrecht-Thaer-Arch., 9: 955-72 (1965). (In German).

The ^{137}Cs content was determined by γ spectrometry in ash samples of various agricultural plants taken from the harvests of 1960 to 1963. The results showed that the ^{137}Cs contents observed in the plants in 1962, and particularly in 1963, were substantially higher than those found in 1960 to 1961 which is in good agreement with the fallout conditions of those years. The ^{137}Cs content of the soils concerned was determined by calculation (soil sampling in June or October 1963), on the basis of the ^{90}Sr content of the soils as well as on the basis of the ^{137}Cs/^{90}Sr activity proportion in fallout. The relative share of ^{137}Cs in surface contamination as well as in root adsorption for 1963 was also estimated by calculation on the basis of the ^{137}Cs data for soils and plants and of the ^{90}Sr data for surface contamination of plants. The results suggest a considerable level of ^{137}Cs surface contamination on plants in 1963. (BBB)

51588 DETERMINATION OF BETA AND GAMMA ACTIVITY IN SAMPLES OF FOODS IN COMMON USE, IN DRINKING WATER, AND IN AIR TAKEN IN THE PROVINCE OF VERCELLI, AND RELATIVE METHODS. Lorenzola, Jolanda Bonardi; Anselmetti, Maria Pia (Laboratorio Chimico Procinciale, Vercelli, Italy). Boll. Lab. Chim. Prov. (Bologna), 18: 501-13 (July-Aug. 1967). (In Italian).

After description of methods for determination of ^{90}Sr and ^{137}Cs, values found in milk, rice, legumes, bread, pasta, eggs, vegetables, fruit, water, and air are reported for ^{90}Sr/Ca, ^{137}Cs/K, and (^{90}Sr/Ca)/(^{137}Cs/K). Two ion exchange methods were found reliable for determining β and γ activity. Milk obtained in bottles from the pasteurizing plant had 15 pCi ^{90}Sr/l, 1.20 g Ca/l, ^{137}Cs 53 pCi/l, 1.21 g K/l; values of interest are lower than those sealed in tetrapak. Removal of Y_2O_3 could not conveniently be done by double precipitation according to older procedures, and a correction procedure involving a delay of 14 days between the first and second precipitations was employed to give results accurate to 10%. Ash was analyzed by extraction of radioisotopes with boiling HCl-HNO_3; the residue did not deviate from background. Analysis of γ radiation did not indicate other elements besides ^{40}K. Total β activity of each sample studied did not exceed the permissible limits; values for water ranged from 0.61 to 3.96 pCi/l in 1966, and activity of air from 0.08 to 0.19 pCi/m^3. (BBB)

51589 BIOLOGICAL SIGNIFICANCE OF δ-ELECTRONS. Wideroee, Rolf. pp 236-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Based on the hypothesis that energies as low as 750 eV are sufficient to induce cell damage (inactivation), investigations are under way on the field of δ-electrons in a body. These δ-electrons pile up at the ends of the primary tracks of higher energy particles in tissues. The significance of this (increase of RBE with depth) to radiotherapy has been established clinically. Dosimetric studies at the cellular level should reveal a great deal regarding the primary molecular reactions that lead eventually to a recognizable radiation injury to a special cell structure. (E.R.B.)

51590 EXPERIENCE FROM THE OPERATION OF THE ARL-62 MOBILE RADIOHYGIENIC LABORATORY. Halik, Jaroslav; Langmajer, Josef. Jad. Energ., 14: 273-5(July 1968). (In Czech).

The mobile radiohygienic laboratory ARL-62 is described and experience gained from five years of operation is discussed. (auth)

51591 CONTRIBUTION TO THE REMOVAL OF RADIOACTIVE POWDERS WITH DIFFERENT SURFACES OF GRAINS. Frkan, Jan; Hodny, Alois; Kratochvil, Jiri (Military Academy, Brno). Jad. Energy., 14: 255-7(July 1968). (In Czech).

Dynamic and static methods for testing surface de-activation are described. Data are given on the results of studies carried out on the influence of particle size on the effective elimination of radioactive dust from surfaces by means of synthetic cleaning solutions. (tr-auth)

51592 APROPOS OF HYGIENIC WORK CONDITIONS IN THE OPERATION OF INDUSTRIAL X-RAY INSTALLATIONS. Klyachina, K. N.; Okonishkova, I. E.; Stolbun, B. M.; Trofimova, L. V.; Sharonova, Z. M. (Inst. of Industrial Hygiene and Occupational Pathology, Sverdlovsk, USSR). Gig. Tr. Prof. Zabol., 10: 9-14(Oct. 1964). (In Russian).

The reported study of two- to three-yr duration of occupational hazards was based on observations of 40 employees of an industrial x-ray installation and 39 employees of medical x-ray departments, males and females, from 20 to 40 yr old, with at least a five-yr employment record. Most subjects complained of fatigue, disturbed sleep, headaches, precordial pain, impairment of sexual function, and digestive disorders. Medical examinations revealed symptoms of hypotonia, vascular nasopharyngeal reactions, asthenic vegetative syndrome, enlarged thyroid glands, leukopenia, qualitative leukocyte changes, thrombopenia, and extended bleeding time. Special tubes for industrial x-ray analysis were used, that yielded comparatively soft radiation, generated at from 15 to 20 or 60 to 70 KV. It was found that the employees were most frequently exposed to radiation during alignment of the four cameras used simultaneously and during periodic control of the cameras' performance. In such cases, the hands received the highest radiation dose, then the head and the neck (particularly the thyroid gland). The observations of 39 employees of medical x-ray departments revealed analogous symptoms of radiation exposure quantitatively; however, the symptoms were more frequent and more severe. The main preventive measure suggested was improvement of the design of structural features of the x-ray apparatus. (BBB)

51593 DETECTION OF CONTAMINATION IN THE CONTEXT OF THE FIRST RADIATION PROTECTION REGULATION (FIRST SSVO). Piesch, E. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Atomwirt., Atomtech., 13: 214-17(April 1968). (In German).

Regulations for daily contamination control of the environment and personnel working with open radioactive materials are considered. Compliance with regulations by licensed dealers of open radioactive materials is determined by supervisors who examine personal dosimeters for contamination. Contamination of the dosimeter indicates but does not prove contamination of the bearer of the dosimeter. It was concluded that more effective contamination control and dose determination less susceptible to error could be obtained by any type of personal dosimeter other than the film type. The rod and phosphate glass dosimeters now used in routine dosimetry are sufficiently insensitive to contamination; possible contamination does not influence the dose but can be determined at the surface of the dosimeter by using other types of detectors. (TSS)

51594 MAGNESIUM-EXTRACTABLE CESIUM IN SOILS AND CESIUM UPTAKE BY PLANTS. Marckwordt, U. (EURATOM, Ispra, Italy). Plant Soil, 28: 372-4(Apr. 1968).

In a greenhouse experiment ryegrass was grown for five months on widely varying soils that had been artificially contaminated with carrier-free ^{134}Cs. A highly significant correlation was found between ^{134}Cs uptake by ryegrass and the amount of ^{134}Cs in the soils that was extractable by $Mg(NO_3)_2$ solution. The ^{134}Cs uptake was not correlated with NH_4-exchangeable ^{134}Cs. It was considered that Mg can exchange with the Cs ions bound on sites to which access was not limited, e.g., by steric hindrance. This exchangeable fraction would thus represent the freely exchangeable Cs of the soil. The high correlation found between Mg-exchangeable Cs and organic matter content was explained by the fact that organic matter was responsible for most of the freely accessible cation-exchange sites in the soil. (BBB)

51595 ACCUMULATION OF ^{137}Cs IN HUMAN BODY, BREAD, AND MILK. Kanareikin, V. A.; Sivintsev, Yu. V. At. Energ. (USSR), 24: 583-4(June 1968). (In Russian).

Measurements of ^{137}Cs accumulation in human body showed that the content of ^{137}Cs decreased continually from June, 1964, to October, 1966, at which date it dropped from 279 to 80 nCi/g K. The content of ^{137}Cs in a human organism decreased from 35 to 13 nCi. The average content of ^{137}Cs in a human organism from May, 1965, to October, 1966, was 20.8 nCi. Graphical data of the uptake of ^{137}Cs by humans in Moscow during 1962 to 1966 and the content of ^{137}Cs in milk and bread during that period are correlated. (R.V.J.)

51596 CHROMOSOMAL ABERRATION IN LYMPHOCYTES FROM AN EXTRACORPOREALLY IRRADIATED PATIENT. Sharpe, Heather. Lancet, 2: 1338-9(Dec. 23, 1967).

The techniques of chromosomal aberration analysis were used in a preliminary study of the dosimetry in the treatment of a patient for reticulum-cell sarcoma by extracorporeal irradiation of the blood. The patient had a nearly normal white blood cell count which was an advantage because the blood lymphocyte cultures were not overwhelmed with a large mass of abnormal leucocytes. Cannulas were inserted into an artery and a vein in the patient's forearm and the irradiation coil was connected between them. Blood passing through the coil was irradiated by ^{137}Cs γ rays at a dose rate of about 80 rad/sec. A blood sample was taken from the venous cannula immediately after irradiation had started, and other samples were taken from the arterial cannula at $1\frac{1}{2}$, $3\frac{1}{2}$, and 25 hr afterwards. The first treatment period lasted $3\frac{1}{2}$ hr. Lymphocytes from the blood samples were cultured in vitro. The day before the extracorporeal irradiation began a sample of the patient's blood was given a dose of 300 rad using x rays from a 2-MeV Van de Graaff generator. The dicentric chromosome yield was 0.82 per cell, with a distribution of dicentrics among the cells as shown in the first line of the table. These data were compared with those for in vitro exposure of blood from a healthy person which was given a dose of 300 rad from 250-KV x rays. The RBE for dicentric yield was about 0.8 for ^{60}Co γ rays relative to x rays. The results showed that in the patient the mean life of lymphocytes in the peripheral blood was about 14 min. (BBB)

51597 PHANTOM DOSIMETRY COMPARING DIFFERENT SOURCES OF IONIZING RADIATION. Meissner, J.; Wendorff, D. Atomkernenergie, 12: 371-3(1967). (In German).

Different sources of ionizing radiations are compared dosimetrically with regard to radiobiological experiments. A tissue-equivalent phantom (plexiglass) is constructed for dose measurements up to 25 cm depth in 5 cm steps at variable distances from the sources. The results for x rays and γ rays are obtained by measuring the "standard ion dose rate", using an ionization chamber. For a neutron source the absorbed dose is estimated from the impulse rates determined by a scintillation counter. Results are presented by graph and by values of the half thickness of the tissue-equivalent phantom material. (auth)

51598 UMWELTRADIOAKTIVITAET UND STRAHLENBELASTUUNG. BERICHT IV/67. (Environmental Radioactivity and Radiation Burden. Fourth Quarter, 67). Bonn, Bundesminister fuer Wissenschaftliche Forschung, 1968. 179p.

The content of the radioactive materials in air, water, soil, and food materials and the radiation burden of the population in the German Federal Republic measured during the fourth quarter of 1967 are reported in graphic and tabular form. (J.S.R.)

51599 EVALUATION AND REDUCTION OF RISKS: THE ROLE OF THE GOVERNMENT IN FORMULATION OF GUIDES AND PROTECTION STANDARDS. Tompkins, Paul C. (Federal Radiation Council, Washington, D. C.). Pediatrics, 41: Suppl., 278-94(Jan. 1968).

This review considers the problems concerned with evaluating the hazards of radioactive fallout, the relation that radiation protection standards may have to such evaluations, and the role of the Federal Government in the formulation of applicable radiation protection guidelines. The general position of the Federal Govern-

ment is that the control of man-made radiation hazards requires team work between agencies of the Federal Government, between the Federal Government and the governments of smaller political subdivisions, and between government and medicine. The Federal Radiation Council recommendations for a general national policy and quantitative guidelines for 2 classes of activities involving radiation are considered. One class, the radiation protection guide, can be used as a basis for the control and regulation of normal peacetime applications of radiation. The other class, protective action guide, provides a basis for evaluation of the circumstances under which remedial action should be ordered by appropriate government agencies to reduce the risk that would otherwise be associated with an accident involving a radiation source. Rules and regulations, when they are appropriate, are formulated by the various federal agencies within the areas of their statutory authority. Any action at any level is the result of a judgment involving the weighing of alternatives. (BBB)

51600 PROTECTION OF THE INFANT DIET: GOVERNMENT AND INDUSTRY. **Nutr. Rev., 195-6 (1966).**

Programs being carried out by federal agencies to assess and reduce hazards of radionuclides and other noxious agents in foods that may be consumed by infants are briefly reviewed. The U. S. Public Health Service is concerned with pollution of air and water, with sanitation problems, and with radioactive fallout. In cooperation with state and local health agencies, it maintains a wide network of surveillance stations. Many local milk ordinances are based on the model published by the Public Health Service. The Atomic Energy Commission is also concerned with the radioactive fallout problem, and with the over-all health hazards of its own installations. The Federal Radiation Council, with members from a number of government agencies, defines safe as well as hazardous levels of various radionuclides, and suggests appropriate protective action where necessary. This task is complicated by the current divergency of opinion, among both experts and nonexperts, as to the potential hazard of low levels of radiation. The U. S. Department of Agriculture is responsible for inspection of meat and poultry. In addition, surveys of radioactivity and pesticide levels in meats are continually underway. (BBB)

51601 EVALUATION AND REDUCTION OF RISKS: PUBLIC HEALTH CONTROL MEASURES AGAINST RADIATION. **Ingraham, Hollis S. (New York State Dept. of Health, Albany). Pediatrics, 41: Suppl., 295-307 (Jan. 1968).**

The New York State radiation monitoring program is used to exemplify public health radiation control measures. The surveillance system in New York began with the monitoring of the effects of weapons testing in 1953 by analyzing surface waters for gross β activity. Today analyses are made from 48 water sources, 5 air sampling stations, 15 milk sampling stations, and 5 rain stations. Water samples are analyzed routinely by gross β and γ scanning for radionuclides. New York State also developed a comprehensive radiation code which covers peacetime radiation sources. The first protective action in New York was to require that all radiation sources be registered or licensed. Control measures in the handling of wastes for burial at the first U. S. nuclear fuels reprocessing plant, which is located in New York State, are described. Surveillance, standards, and safeguards are examined in terms of the responsibilities of the 3 levels of government involved. Several research programs in New York are reviewed. (BBB)

51602 RADIATION DOSIMETRY FOR CLEFT PALATE PATIENTS. **Landa, Lloyd Sherwin; Shapiro, Gerald; Silverman, Sidney I.; Storch, Charles B. (New York Univ., N. Y.). Cleft Palate J., 4: 308-15 (Oct. 1967).**

Cleft palate patients receive considerable x-ray exposure in the course of diagnosis of problems related to speech, dental, and medical study of their congenital anomalies. The x-ray dosage was a result of still films and cineradiographic studies, as well as specialized laminagraphic and tomographic procedures being used. Additional radiation exposure occurred during and after cleft palate therapy. An evaluation of dosimetric data for routine cleft palate examination gave a value of 560 R cm^2 or 8.3 rad to the skin. In general, radiation exposure should be kept to an absolute minimum, consistent with the objective of obtaining the required diagnostic information. To this end, a radiographic procedure was devised which incorporated many precautions and safeguards. The following suggestions were proposed to keep dose at the lowest level: a high-gain image amplifier, properly adjusted for optimum film quality and brightness; freshly mixed developing solutions; high resolution, high-speed film (that is, linagraph Shellburst EK); adequate protective devices (that is, full-covering lead apron, eye shield, thyroid shield, and small field size); image orthicon television system for positioning of patient; periodic systematic reevaluation of the radiography protocol; constant monitoring of the dose; proper patient radiation history; complete patient dose control records; and establishment of a maximum limit for total dose for cleft palate examination in children (10 R to critical areas). (BBB)

51603 NORTH CAROLINA'S RADIATION PROTECTION PROGRAM. **Wilson, William L. (North Carolina State Board of Health, Raleigh). N. C. Med. J., 28: 54-7 (Feb. 1967).**

Accomplishments of the Radiation Protection Program of the North Carolina State Board of Health, in effect for the past 2 yr, are surveyed. Air has been collected at 18 sampling stations and the trapped particulate matter analyzed for ^{131}I and ^{140}Ba. Samples of water have been collected at 154 stations including ground water, surface water, and rainfall, and analyzed for gross β activity. Periodic samples of milk have been collected at 6 stations and analyzed for ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, and ^{140}Ba. In occupational surveillance, attention has been concentrated on x-ray machines and radioactive materials. Subject to state regulations are 3000 x-ray machines, of which ~1300 are dental, 1400 medical, and 100 industrial. Of 409 total registrants whose facilities were inspected, 223 or 54% failed to comply with one or more of the regulations. The types of 456 radiation machines involved, of which 273 (60%) failed to comply, are shown in a table. Noncompliance was even more prevalent with reference to the possession or control of radioactive materials, particularly Ra. During the past 2 yr, of 92 licenses inspected, 76 (82%) failed to comply with one or more regulations. Registrants are provided with a directory of sources, federal and state as well as individual, to whom they may apply for leak-test services, equipment- and instrument-servicing, calibrations, consultations, and surveys which will enable them to comply with the regulations in full. (BBB)

51604 SOCIAL PROBLEMS OF FALLOUT: NATURE OF PUBLIC CONCERN AND PSYCHOLOGIC REACTION. **Spock, Benjamin M. (Western Reserve Univ., Cleveland). Pediatrics, 41: Suppl., 342-51 (Jan. 1968).**

Problems relating to public knowledge and concern of fallout and the responsibility of government agencies to keep the public better informed are discussed. It is proposed that, until there is proof that low-level radiation is harmless, there should be continual research, guidelines, and the establishment and promulgation of explicit plans of action for government officials, physicians, the dairy industry and perhaps other food processors, and the public, in case fallout increases markedly again. Solutions to the problem of fallout cannot be decided by scientists alone, nor should it be left to military leaders. In the democratic system public opinion is expected to provide guidance. Yet, public opinion on important nuclear questions remains largely uninformed. To present the public the raw materials from which this opinion can be derived is both the privilege and duty of the scientists. Public awareness of the dangers of radioactive fallout and civil defense needs has been stifled by unreasonable restrictions on information relating to the effects of nuclear weapons. (BBB)

51605 ROLE OF THE ATOMIC ENERGY COMMISSION IN BIOMEDICAL RESEARCH. **Bruner, H. D. (Atomic Energy Commission, Washington, D. C.). J. Miss. State Med. Ass., 7: 511-12 (Oct. 1966).**

Responsibilities of the Division of Biology and Medicine of the AEC are reviewed. The mission of the Division is 3-fold: 1) To learn what are the effects of radiation on living structures and on their ecological relations, 2) to learn what can be done to counteract or modify these effects of radiations, and 3) to find how radiations and radioactivity can be put to use for the benefit of mankind. The Division's research programs cover 14 areas of interest, including molecular and cellular level studies, radiation genetics, somatic effects, toxicity of radioelements, environmental radiation studies, and radiological physics. These areas account for about two-thirds of the research effort. Investigations of the practical health and safety problems encountered in the development of nuclear energy are also supported. Cancer research and selected beneficial applications account for a small percentage of the total effort. (TSS)

51606 RESPONSIBILITY OF MEDICINE FOR MEETING RISKS: RELATION OF MEDICINE TO THE PROBLEM OF RADIOACTIVE FALLOUT. **Farr, Lee E. (M. D. Anderson Hospital and Tumor Inst., Houston, Tex.). Pediatrics, 41: Suppl., 373-8 (Jan. 1968).**

The problems of assessing radiation hazards and informing the public are reviewed. The role of medical opinion in this regard is emphasized. The legislator may be impatient with the physician who says that radioactive fallout is harmful but will not state explicitly the levels at which specific harm is generated. On the other hand, physicians will not now state definite levels below which exposure to radioactive fallout need not be reduced. The question is not one for which data are available which merely requires classification in order to provide a clear answer. Yet, if the informed physician remains silent, the public will receive

poor advice in this regard from those inadequately informed. How this dilemma can be resolved is discussed. It must be resolved by medicine devising mechanisms for action of qualified physicians that may effectively disclose thereby where the areas of scientific ignorance exist that this condition may be remedied; where the areas exist of knowledge, but inadequate in extent and depth to give a reasonably correct answer, that these may be highlighted; and where the areas of scientific agreement exist that these may be clearly delineated. When such information evaluation becomes part of the screening procedure for data to be given to the public, it will allow also estimates to be made of the reliability of the conclusions drawn and these estimates can be understood by members of the body politic. (BBB)

51607 RESPONSIBILITY OF MEDICINE FOR MEETING RISKS: PANEL DISCUSSION AND SUMMATION. **Farr, Lee E. (M. D. Anderson Hospital and Tumor Inst., Houston, Tex.); Lis, Edward F.; Yamazaki, James N.; Wheatley, George M.; Wehrle, Paul.** Pediatrics, 41: Suppl., 361-72(Jan. 1968).

Various aspects of reduction of exposure to the population, particularly those that concern the pediatrician, are discussed. A concentrated attempt is being made in most children's hospitals to monitor radiology equipment, to reduce the extent of scatter, and to see that the x-ray machine is functioning properly. With regard to differences in susceptibility to radiation damage among children, sex and age-related variability are discussed. The determination of effects in the individual radioactivity exposure requires (1) careful determination of the radiation dose absorbed by the individual, (2) careful longitudinal clinical pathological study and evaluation of the exposed individual, and (3) interpretation on an epidemiological basis of the accumulated data from (1) and (2) of the population under scrutiny. Feasibility of studying the effects of relatively high body burdens of ^{137}Cs in Arctic populations is considered. Measures pediatricians might take if fallout levels were to rise again are outlined. (BBB)

51608 SOCIAL PROBLEMS OF FALLOUT: RESPONSIBILITY OF THE NEWS MEDIA: THE QUALITY OF OUR ENVIRONMENT. **Bengelsdorf, Irving S. (Los Angeles Times, Calif.).** Pediatrics, 41: Suppl., 352-60(Jan. 1968).

Development of applications of nuclear energy with concomitant contamination of the atmosphere with radionuclides is discussed in the context of dissemination of information of possible hazards among the public. It is the responsibility of the news media to provide the facts for the population to enable them to hold discussions among themselves and to try to communicate intelligently with scientists. For people to retain some choice as to the direction the society takes, discussions of the impact of science and technology upon society are of extreme importance. And, it is up to the news media to provide the scientific and technological facts which can serve as bases for discussions among the public. The news media should be actively informed of the objective factual events concerning peacetime radioactive fallout and any other controversial aspect of widespread pollution. It is becoming more and more evident that modern technology, as used by society, alters the environment on a vast global, national, statewide, and community scale. The changes brought about often are subtle, low-level, chronic situations. Problems created by technology cannot be solved by technology alone. The potential threats of radioactive fallout pollution of the whole globe are consequences of political, military, social, and economic considerations. They may be technological in origin, but their solution lies elsewhere. (BBB)

51609 EVALUATION AND REDUCTION OF RISKS: PROBLEMS AND APPLICATIONS OF INDIVIDUAL CONTROL MEASURES. **Filer, Lloyd J. Jr. (Univ. of Iowa, Iowa City).** Pediatrics, 41: Suppl., 308-21(Jan. 1968).

Concern is given to measures to control human radiocontamination resulting from radionuclide contamination of air, water, and food supply. A model relating body burden of radionuclide to dietary intake based on data derived from metabolic balance studies is considered. A discussion is presented of individual control measures from the standpoint of the patient or subject rather than the isotope. Since peak intakes of radionuclides by the population seem to have occurred in 1964, the health risks from radioactivity in food over the next several years are too small to justify protective actions to limit the intake of radionuclides by radical changes in dietary patterns. However, it is possible for pediatricians to limit radionuclide intake of infants by the following methods: increasing the number of breast-fed infants, prescription of soy formulas, and prescription of formulas prepared from demineralized non-fat milk and whey. Fluid milk intake in excess of 1 qt/day by young children and adolescents should be discouraged. (TSS)

51610 RECTAL DOSE MEASUREMENT WITH CdS DOSIMETERS. **Koschel, K. W. (Cancer Inst., Melbourne).** Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 837-42(Aug. 1968).

A simple dosimeter is described for the measurement of a rectal γ dose from radon or radium implants used in the treatment of cancer of the cervix. The unit incorporates a CdS scintillation dosimeter and a transistorized D. C. amplifier, enabling dose-rates of 0 to 100 R/hr., 0 to 200 R/hr., and 0 to 500 R/hr. to be measured on three meter ranges. These units have been used over a period of 2 years and are capable of measuring a radiation dose to the rectal wall with an accuracy of 5 per cent. (auth)

51611 DEPTH DOSE STUDIES IN ELECTRON BEAM THERAPY: EFFECTS ON ANAGEN MOUSE HAIRS. **Lanzl, Lawrence H.; Malkinson, Frederick D.; Ahrens, Thomas J. (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago).** Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 863-70 (Aug. 1968).

Detailed physical and biologic depth dose studies for a 20 MeV scanning electron beam are reported to further elucidate the clinical impression of skin sparing effect observed when electron beams are used for cancer therapy. The biologic dosimeter used was the damaging effect on anagen mouse hair by electron irradiation. There was substantial agreement of the surface-to-plateau dose ratio between the photographic film and thermoluminescent dosimeters and biologic dosimeters utilized. Even though the linear energy transfer (LET) cannot be expected to be identical at the surface as compared with the depth, this difference has not produced a significantly different RBE at the two positions for the biologic indicator used. (auth)

51612 PHANTOM THERMOLUMINESCENT DOSIMETER COMPARISON FOR A COOPERATIVE RADIOTHERAPY TRIAL. **Worsnop, B. Ralph (Univ. of California, San Francisco).** Radiology, 91: 545-53(Sept. 1968).

Radiotherapists from 15 institutions participated in a study of dose distribution from ^{60}Co γ beams used for therapy. An Alderson Rando phantom with about 350 LiF thermoluminescent dosimeter capsules distributed throughout the area of a lung and with radiographic shadows from a human patient incorporated to simulate a neoplasm in the phantom was passed among the participants. Dosimeters were also arranged in the non-malignant lung and other body sections to measure the dose caused by leakage and scattered radiations. The phantom was accompanied by two radiographs and a biopsy report on the human patient. Each radiotherapist was asked to administer one-tenth of the dose that he would deliver to a human patient. Attempts were made to correlate the results with various factors concerning the therapeutic equipment used by the various participants. A Lucite cube containing six thermoluminescent dosimeters and irradiated with 450 RADS by each participant was compared with a similar cube used as a standard. Results showed a considerable difference between the participants in the exposure of the phantom to the radiation field. It was concluded that this observed difference could have a profound effect on the value of the groupings of statistics from the various institutions if extended to live patients in a clinical trial. (C.H.)

51613 ISOENERGY DISTRIBUTION FOR A TYPICAL ^{60}Co TELETHERAPY UNIT. **Krohmer, Jack S.; Adamski, John (Roswell Park Memorial Inst., Buffalo).** Radiology, 91: 559-61(Sept. 1968).

A platinum-carbon dual ionization chamber was calibrated and used to plot isoenergy curves for a typical ^{60}Co γ teletherapy unit in a water phantom. The dual ionization chamber was calibrated using several reference radiation beams whose energy distributions had been determined with a total absorption photon spectrometer. The dual chamber was moved and positioned by remote control within a 10 × 10-cm ^{60}Co γ irradiated field in a water phantom. Effective energies at various positions within the phantom were obtained from the ratio of ionization readings in the platinum and carbon chambers. An isoenergy distribution curve for a ^{60}Co γ beam was plotted. (auth)

51614 PROTECTING DEVICE FOR RADIUM STORAGE DRAWERS. **Bedrosian, Paul H. (Southeastern Radiological Health Lab., Montgomery, Ala.).** Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 919-20(Aug. 1968).

A device is described that would prevent lead drawers used for the storage of sealed radium sources being closed unless all sources were properly seated. The device would help prevent contamination caused by the rupture of sources broken or sheared by the closing action of the storage drawer. (C.H.)

51615 THE CONTENT OF SOME FISSION PRODUCTS IN FOREST VEGETATION. **Gedeonov, L. I.; Rosyanov, S. P. Pochvovedenie, No. 7, 88-90(1968).** (In Russian).

The contamination with ^{90}Sr, ^{137}Cs, ^{144}Ce, and $^{95}Zr-^{95}Nb$ of birch leaves and pine, fir, and spruce needles, sampled in 1962, was studied. Results showed that the content of fission products in birch leaves depends upon their age, and the content of these radio-

nuclides is higher in spruce needles than in pine needles. The differences in the radioactive contamination of different fir tree species are due to the ability of the trees to retain the atmospheric precipitation. (auth)

51616 DETERMINATION OF ^{137}Cs AND RELATED SAMPLING PROBLEMS OF DAIRY CATTLE FEEDS, 1962–1967. Ward, G. M.; Johnson, J. E.; Whelan, D. L. (Colorado State Univ., Fort Collins). J. Ass. Offic. Anal. Chem., 51: 792-6(July 1968). (COO–1171-58).

Samples of feeds fed to dairy cattle on the university farm were analyzed from 1962 to 1967 for fallout ^{137}Cs by means of γ-ray spectrometry. Maximum levels were observed in first-cutting alfalfa hay in 1963 (3600 pCi/kg). Second and third cuttings each year were lower by factors of two to six. Levels declined each year after 1963 to barely detectable levels in mid-1967. Pasture forage or green-cut alfalfa contained concentrations of ^{137}Cs similar to hay with the same seasonal and yearly patterns. Corn silage contained levels similar to later cuttings of hay. Grain mixes contained levels which were lower than forages by a factor of 10 in 1962 to 1963 but approached equal levels in subsequent years. The results indicated that sampling was much more important than radiation counting in explaining variation between sampling. The levels of ^{137}Cs found in the feeds was readily explained in terms of observed patterns of fallout during this period. (auth)

51617 DETERMINATION OF THE ACTIVITY OF TRITIUM IN A BIOLOGICAL PREPARATION BY MEANS OF AUTORADIOGRAPHY. Kortukov, E. V. (Moscow Inst. of Medicine). Med. Radiol., 13: 66-9(Sept. 1968). (In Russian).

At present there is no quantitative method of autoradiography with the use of tritium. On the basis of 74 group calculations of the tritium spectrum and traces of beta particles of this spectrum in a substance of unified density, the coefficient of autoscreening of tritium radiation in the tissues was determined. Methods for determining the specific activity of labeled tritium, depending on a number of parameters, are discussed. (auth)

51618 DISTRIBUTION OF DEPTH DOSES OF BREMSSTRAHLUNG WITH MARGINAL ENERGY OF 25 MeV IN HETEROGENIC MEDIUM. Tsybul'skii, B. A.; Lyapidevskii, V. K.; Mil'shtein, R. S. (Moscow Scientific-Research Inst. of Roentgen-Radiology). Med. Radiol., 13: 70-7(Sept. 1968). (In Russian).

The principal types of heterogeneities influencing the distribution of depth doses of bremsstrahlung were determined. Their equivalents on weakening relative to the muscular tissue are presented. A series of curves of depth dose distribution in a medium was obtained with ionization chambers. The technique of constructing the dose field in a heterogenous medium (phantom) with air cavities is described. (auth)

51619 THE MAXIMUM PERMISSIBLE CONCENTRATION OF GASEOUS TRITIUM IN THE AIR OF INDUSTRIAL PREMISES. Shtukkenberg, Yu. M.; Zhuravlev, V. F. (Inst. of Biophysics, Moscow). Gig. Sanit., No. 8, 44-8(Aug. 1968). (In Russian).

The penetration of gaseous tritium through the skin and the respiratory organs and the periods of half-elimination of the isotope from the body of rats after its inhalation are discussed. Values for the maximum permissible concentration of gaseous tritium in the air of industrial premises are recommended. (auth)

51620 USE OF THE "STEBEL" γ APPARATUS IN EXPERIMENTAL RADIOBIOLOGY. Ratner, T. G.; Afanas'ev, A. M.; Yarmonenko, S. P.; Kuznetsov, Yu. D. (Inst. of Biophysics, Pushchino, USSR. Inst. of Labor Hygiene and Occupational Diseases, Moscow). Radiobiologiya, 8: 453-5(1968). (In Russian).

A dosimetric investigation was made of the dose distribution within the working chamber of the Stebel apparatus with a radioactive charge of ^{137}Cs, which broadens the possibility of utilizing it in radiobiological experiments where it is necessary to know the exact dose distribution over the volume being irradiated. The dose distribution was measured in air and a tissue equivalent phantom by chemical dosimetry. The dose rate in the center of the chamber can be varied from 750 to 100 Rad/min with the aid of inserted lead shields. By considering the parameters studied, good reproducible conditions of irradiation and accuracy of dosimetry can be ensured. (JPRS)

51621 ADSORPTION OF RADON DAUGHTERS TO SOME POLYDISPERSE SUBMICRON POLYSTYRENE AEROSOLS. Raabe, Otto G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys., 14: 397-416(May 1968).

The adsorption of radioactive materials to aerosols is an important consideration when assessing the hazard associated with the inhalation of radioactive materials. The adsorption of radon daughters to aerosols is of particular interest since it is probable that such attachment represents the primary hazard in uranium mining. The adsorption of radon daughters to polydisperse aerosols of polystyrene spheres in the diameter range from 0.04 to 0.5 μ was studied. Electron micrographs were used to characterize the aerosols. The Goetz Aerosol Spectrometer was employed with a new analysis method to relate the quantity of adsorbed radon daughters to aerosol particle size, after radon gas in concentrations around 2×10^{-8} Ci/l interacted with aerosols in concentrations of about 10^4 particles/cc. The results showed that the relative quantity of adsorbed radon daughters on different size aerosol particles up to 0.5 μ in diameter was proportional to the surface area of the particles. A theoretical explanation is developed which suggests that the Brownian motion of the aerosol particles cannot be ignored even though their diffusion coefficients are relatively small, and that the diffusion relationships for highly diffusable materials interacting with aerosols only apply for very high interaction rates. For low interaction rates the dynamical character of aerosols favors random surface interactions rather than diffusion gradients. (INIS) (UK)

51622 BREATH IONIZATION FROM RADIONUCLIDES DEPOSITED IN THE LUNGS. Sanders, S. Marshall Jr. (E. I. du Pont de Nemours and Co., Aiken, S. C.); Brown, Mark. Contract AT(07-2)-1. Health Phys., 14: 431-8(May 1968).

A study was undertaken to determine if the lung burden of radioactive materials can be evaluated by measuring ions in exhaled breath. A spiroelectrometer was developed which measured the quantity of ions in exhaled breath. The ability of ions to pass through small passages such as subsegmental bronchi and remain detectable was confirmed in vitro; the ions produced by 1 nCi of ^{239}Pu in moist oxygen were detectable after passing through 33 cm of plasticized polyvinyl chloride and rubber tubing with a 1.6-mm-dia lumen. Ninety nanocuries of ^{239}Pu electrodeposited on the end of a fine platinum wire were placed at various locations in the tracheobronchial tree of four anesthetized dogs. Ions were detected from all locations except when the source became wedged in a terminal bronchiole. Ions were not detected in the breath of two dogs 70 days after they had assimilated 12 and 18 μCi of $^{239}PuO_2$ aerosol. A sequential study over a 27-hr period following assimilation of 2.7 μCi of $^{239}PuO_2$ aerosol revealed no ionization, except during a 4-hr period when the ^{239}Pu was found in the mucus. Further study indicated that ions produced in the lobular region by assimilated ^{239}Pu are lost because of turbulence in this region. (INIS) (UK)

51623 ASSAY OF SKELETALLY DEPOSITED ^{90}Sr IN HUMANS BY MEASUREMENT OF BREMSSTRAHLUNG. Dudley, R. A.; Haim, A. Ben (International Atomic Energy Agency, Vienna). Contract AT(30-1)-2819. Health Phys., 14: 449-59(May 1968). (IAEA–2819-7).

An evaluation is presented of the accuracy and sensitivity with which skeletally deposited ^{90}Sr can be assayed in humans by measurement of bremsstrahlung with whole-body counters of various designs. The yield of bremsstrahlung from skeletal deposits of ^{90}Sr and equilibrated ^{90}Y can be duplicated within about 10% using ^{90}Sr sources in appropriate small plaster of paris and Lucite absorbers. The efficiency of measurement of bremsstrahlung produced in the body (counts per photon) can be calibrated probably within 5% by measurements on in vivo tracer doses of the γ-ray emitting nuclides ^{47}Ca or ^{85}Sr. Under a particular set of measurement conditions the assay of ^{90}Sr at the nanocurie level in normal people has been found to show a standard deviation of about ±15 nCi; this error results mainly from uncertainties in separating the bremsstrahlung component of the radiation spectrum from all other components. (INIS) (UK)

51624 DIRECT CALIBRATION USING GAMMA SPECTROMETRY FOR MEASURING RADIOACTIVITY IN HUMANS. Olson, D. G. (Atomic Energy Commission, Idaho Falls, Idaho). Health Phys., 14: 439-47(May 1968).

A major problem encountered in measuring radioactivity in humans is the fundamental calibration of the instrument. A procedure is described by which the quantity of in vivo radioactivity can be evaluated entirely from theoretical calculations, eliminating the need for obtaining the radioactive standards necessary in the usual empirical methods of calibration. Knowing the geometrical source-to-detector configuration and the mass absorption coefficient for NaI, the number of gamma-rays emitted from a source that are totally absorbed in a known volume of crystal can be calculated. Gamma-rays which are partially absorbed by the detector are corrected for by applying the appropriate factor from a peak-to-total ratio plot. Absorption of the gamma-rays in muscle and bone can be predicted by using the mass absorption coefficients given. The gamma-rays found in the photopeak of the gamma spectrum can thus be measured and used to determine the number of gammas emitted by the source. The reliability of the method was shown by the results of administering ^{40}K, ^{42}K, ^{41}Ar, ^{54}Mn, ^{132}Cs, and ^{137}Cs, to human volunteers and measuring the response. The proposed

procedure gave a smaller error than the conventional empirical method. (INIS) (UK)

51625 EXPERIMENTAL DATA ON THE PRODUCTION OF ^{41}Ar IN REACTOR EXPOSURE ROOMS. McManaman, V. L.; Leonard, B. E. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Health Phys., 14: 515-17(May 1968).

A study was made to determine the amount of, and the basic mechanisms for, argon-41 production (fast and thermal neutron activation by wall scattered and unscattered neutrons) in one of the AFRRI-TRIGA reactor exposure rooms. With this information it may be learned if room modification would reduce the production, by what total amount, and what material would be effective. (INIS) (UK)

51626 DOSE AND PHOTON-ENERGY MEASUREMENTS FOR BONE MARROW IN A HUMAN PHANTOM BY THERMOLUMINESCENCE. Facey, Robert A. (Defence Chemical, Biological, and Radiation Labs., Ottawa). Health Phys., 14: 557-68(June 1968).

The shape of the curve of dose to bone marrow against photon energy for a human phantom exposed to rotational whole body x radiation has been in some doubt. A monotonic curve has been obtained by chemical dosimetry. A hump is seen at around 100 keV effective on the curve obtained by the thermoluminescence method. This hump could possibly be artificial if there were sufficient energy degradation inside the phantom to shift the response of the dosimeter system. The author has remeasured this curve and has confirmed its general shape. The amount of energy degradation was investigated by depth–energy curves, obtained with a combined thermoluminescence system ($LiF + CaSO_4$:Sm). The depth–energy curve shows two mechanisms—a softening of the incident radiation in the soft tissue, followed by a hardening in bone. The mean energy for dose to bone marrow was shown to be 120 keV effective for 168-keV effective incident, and 77 keV for 100-keV incident. This degradation was insufficient to create an artificial hump. Energy effects inside water phantoms are discussed, together with factors operating on the magnitude of the absorbed dose (particularly the effect of the size of irradiated area, and the effect of bandwidth). These produce a satisfactory qualitative explanation of the shapes of the depth–energy curves and of the dose to bone marrow curve. (INIS) (UK)

51627 ^{226}Ra AND ^{210}Pb IN HUMAN TEETH AND BONES. Lovaas, Arvin I.; Hursh, John B. (Univ. of Rochester, N. Y.). Health Phys., 14: 549-55(June 1968).

A study on the suitability of using measurements of certain isotopes in tooth to estimate levels of the same isotopes in bone is reported. Human tooth, jaw, tibia shaft, calvarium, femur head, and rib from thirteen autopsies were analyzed for ^{226}Ra, ^{210}Pb and stable calcium. The degree of uniformity among subjects of the tooth–bone ratio for each type of bone was examined by rank-difference correlation. The calculated coefficients were consistent with the existence of a high positive correlation between tooth and bone burdens of the isotopes measured. Regression analysis using the data as a calibration set led to the prediction that in future sampling when tooth is measured at or above the presently reported mean level for ^{226}Ra, the mean bone value will lie within approximately ±50% of the tooth value at the 95% confidence level. Lead-210 level predicted for bone is subject to larger error and is more dependent on the bone type to which the tooth level is referred. (INIS) (UK)

51628 DIELECTRIC ABSORPTION OF MICROWAVES IN HUMAN TISSUES. Mallard, J. R.; Whittingham, T. A. (Univ. of Aberdeen, Scotland). Nature (London), 218: 366-7(April 27, 1968).

Reference is made to an earlier publication in which were given the results of calculations on the propagation of 3 cm plane microwaves in a semi-infinite plane stratified slab of tissues, simulating the effect of the beam on the human body. It has been realized that the attenuation coefficients employed were amplitude and not power coefficients. As a result the numerical results were incorrect, although the essence of the conclusions was correct. The calculations have been repeated by an independent method using a digital computer and the correct attenuation coefficients. The calculations were also extended to two other frequencies. The model employed consisted of a slab of normal tissue, bounded on each side by a 1 mm layer of skin, and a slab of tumor tissue was situated at various positions inside the normal tissue. Results were intended to provide only a rough indication of those to be expected in vivo. It is emphasized that the plane nature of the model produces interference effects, arising from multiple reflections between parallel interfaces, which would not be expected in vivo. Diffraction and refraction effects would be very important for small tumors in real anatomical situations. Results are summarized both for transmitted and reflected power. (INIS) (UK)

51629 MEASUREMENTS OF ^{137}Cs IN HUMAN BEINGS IN 1958–67. Godfrey, B. E.; Vennart, J. (Radiological Protection Service, Belmont, Eng.). Nature (London), 218: 741-6(May 25, 1968).

The amounts of radiation from fallout cesium-137 in the bodies of a number of people in a heavily populated region were measured and an estimate made of the amounts likely to be received in the future, assuming that there is no large-scale testing of nuclear weapons. (INIS) (UK)

51630 WHOLE BODY COUNTING OF PLUTONIUM IN RATS. Logan, R.; Todd, R. (United Kingdom Atomic Energy Authority, Chapelcross, Scotland). Int. J. Appl. Radiat. Isotop., 19: 422-5(April 1968).

In earlier studies the authors showed that radiation from plutonium-237 injected into rats was detectable outside the living animal and permitted some localization of plutonium-239 carrier in the anaesthetized animal. A method for the determination of the Pu-burden of an unanaesthetized animal using plutonium-237 as label for plutonium-239 is described, using the whole body counting technique. (INIS) (UK)

51631 RADIOBIOLOGY AT C.E.N. IN MOL. Maisin, J. (CEN, Mol, Belg.). Bull. Acad. Roy. Med. Belg., 7: 363-73 (1967). (In French).

As a result of the 1955 international conference in Geneva on the peaceful uses of atomic energy, a committee was formed to create a Radiobiology Department at the C.E.N. in Mol. Some results of its research projects are reviewed. (TSS)

51632 THE QUALITY FACTOR FOR LOW-ENERGY β-EMITTERS. Vennart, J. (Radiological Protection Service, Surrey, Eng.). Health Phys., 14: 541-8(June 1968).

The experimental evidence for the RBE of β-particles from tritiated water is reviewed. Reported values are in the range 1–2. This variation is not remarkable in view of the different end points used, but it is also due to experimental errors, to different views concerning the spatial distribution of dose, to the quality of the reference radiation, and to dose rate. The results are reviewed in relation to recommendations of I.C.R.P. concerning QF and it is concluded that a value of QF different from unity for either tritium or other β-emitters is hardly justified. (INIS) (UK)

51633 DETERMINATION OF GROSS ALPHA ACTIVITY IN URINE BY ADSORPTION ON GLASS FIBRE FILTER PAPER. Eakins, J. D.; Gomm, P. J. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys., 14: 461-72(May 1968).

A description is given of work carried out to determine the optimum conditions for maximum surface adsorption of a number of alpha emitting radioelements on glass fibre filter paper. The effect of valency, pH and presence of pyrophosphate is discussed, and a new technique for the determination of gross alpha activity in urine is given based on surface adsorption. Overall recoveries of thorium, protactinium, neptunium, plutonium, americium and curium are about 80% using this procedure. The advantages of surface adsorption over conventional ion exchange are discussed, and the development of other procedures based on this principle is suggested. (INIS) (UK)

51634 PROBABILISTIC METHOD OF APPRAISING BIOASSAY SAMPLING PROGRAMS. Knight, F. D.; Sanders, S. M. (E. I. du Pont de Nemours, Aiken, S. C.). Contract AT(07-2)-1. Health Phys., 14: 523-4(May 1968).

A new criterion is described to appraise health physics sampling programs. This criterion, used with programs of periodic urinalyses, is the probability of detecting a single assimilation of a specific quantity of a radionuclide by anyone in a group of individuals. (INIS) (UK)

51635 SOCIAL PROBLEMS OF FALLOUT: THE CRISIS TECHNOLOGY POSES FOR POLITICAL INSTITUTIONS. Holman, Halsted (Stanford Univ., Palo Alto, Calif.). Pediatrics, 41: Suppl., 322-31(Jan. 1968).

Role of the government in the control and regulation of public health hazards, particularly those relating to nuclear energy, is discussed. An example of inappropriate relations between science and government involving radioactive fallout is cited. For years the government minimized the problem of fallout, appeared unaware of most of the biological consequences of fallout, did not foster debate among nongovernment scientists, and failed to inform the public of the problem, or of the level of knowledge of it. It is suggested that identification of the principal biologically important radioactive elements in fallout, and in particular, their hazards to health, was made by nongovernment scientists who were neither consulted nor encouraged in their work. Furthermore, it is alleged that the government was careless in planning for radioactive waste disposal or for reactor development as evidenced by the proposed site location over an earthquake fault

at Bodega Bay. Only an aroused and unassisted citizenry prevented unwise action in these instances. Other examples are cited that reveal relations between government and science which were not characterized by restraint, accuracy, or candor on the government's part. Nor do they reveal the government, acting as the representative of the people, demanding such characteristics from the representatives of nongovernmental agencies. The central challenge that science and technology pose is whether man can control and use his own achievements for his benefit. If this objective is not accomplished, technology may strengthen the power of a few and result in great damage to the natural environment and perhaps to our democratic institutions. (BBB)

51636 METHODS OF DOSIMETRY FOR TELETHERAPY. **Schoknecht, Guenter (Auguste-Viktoria-Krankenhaus, Berlin). Roentgenpraxis, 19: 238-48(Sept. 1966).**

The most practicable methods of dosimetry using electronic equipment are discussed. These include dose matrix procedures, the method of linear decrements, and separation methods. Dose matrix methods require establishment of dose distribution patterns from isodose curves. Typical examples of measurements in phantoms and a stationary field isodose pattern with superimposed polar coordinates, for a 6×10 cm^2 ^{60}Co field are shown. The chief disadvantage of this method is the continuous change in source-body surface distance that accompanies the movement during irradiation. The linear decrement method is used to evaluate stationary dose distribution. The method is illustrated by an example of a ^{60}Co 6×10 cm^2 stationary field, derived from a 50% decrement line of an isodose pattern. This method is useful for irradiation evaluation at various angles of irradiation and for multiaxial moving irradiation patterns. Calculations are more complex than the dose matrix procedures, but it is most useful for ^{60}Co irradiation fields. Separation methods are valuable for evaluation of primary and scattered radiation components. The applications of computer methods to dosimetry are discussed briefly, and several examples with calculations are presented. (BBB)

51637 PHANTOM DOSIMETRY STUDY OF SHAPED ^{60}Co FIELDS IN THE TREATMENT OF HODGKIN'S DISEASE. **Meurk, Mary Louise; Green, Jerold P.; Nussbaum, Herman; Vaeth, Jerome M. (Claire Zellerbach Saroni Tumor Inst., San Francisco. Mount Zion Hospital and Medical Center, San Francisco). Radiology, 91: 554-8(Sept. 1968).**

A study was performed to evaluate the dosimetry of the mantle technic in the treatment of Hodgkin's disease, comparing the measured dose in the phantom with two calculation methods. Using the Alderson phantom man and a ^{60}Co γ teletherapy unit, the clinical situation was simulated and repeated lithium fluoride measurements were made throughout the node-bearing areas and at several other sites of interest. The results of this study are reported and recommendations made concerning the methods of calculating dose. (auth)

51638 RADIOPROTECTION IN MEDICINE AND REGULATIONS. **Seelentag, Walter (Bundesgesundheitsamt, Berlin). Roentgenpraxis, 19: 223-38(Sept. 1966). (In German).**

Several aspects of radiation protection: how the unexpected can be avoided, what is possible, and what is required to provide radiation protection are discussed. The roles of the type of radiation to be used, the type of irradiation effect desired, such as radiotherapeutic effects, avoidance of side effects, and hazards to medical personnel are discussed. The necessity of radiation protection to avoid somatic effects, somatic-stochastic effects and genetic effects is emphasized. The role of legal regulations to ensure adequate radiation protection is discussed. Various features of these regulations are discussed, particularly as to special problems associated with the medical applications of radiation protection. That no law or regulation designed to ensure radiation protection is any better than the way it is carried out is also emphasized. (BBB)

51639 POSSIBILITIES OF RADIOACTIVE CONTAMINATION IN NUCLEAR WAR. **Waters, W. R. (Dept. of National Health and Welfare, Ottawa, Ont.). Union Med. Can., 96: 67-70(Jan. 1967). (In French).**

Hazards of population exposure in three types of radiological environments are considered: peacetime industrial and medical use of radiation and radioactive materials, peacetime testing of low and high yield nuclear weapons, and massive wartime use of high yield weapons. The various risks involved are considered in relation to each other, and the considerable difference in importance between area and personal contamination by fallout is emphasized, with reference to quantitative examples. It is shown that personal contamination is of a low order of risk when compared with that arising from area contamination. Thus, the potential injury due to γ irradiation from fallout carried on the person will be very much less serious than that resulting from whole-body irradiation from fallout in the contaminated area. The difference is of the order of thousand-folds. Injury from β irradiation is negligible from area contamination but is the dominant injury from fallout matter carried on exposed skin. Beta radiation, however, is confined to the integument and is not comparable in gravity to whole-body γ radiation. Former concepts of radiation protection, calling for elaborate procedures and extreme cleansing of the contaminated individual, reflected the influence of the high standards of radiological cleanliness as a proper practice in peacetime. In nuclear war, however, a higher risk of injury is accepted and the main effort is directed to saving life, then to reducing the potential injury from whole-body γ irradiation and finally to the prevention of skin injury. The first two hazards are reduced by shelter facilities, and the latter by early removal of contaminated clothing and cleansing of exposed skin. The problem of the build-up of radiation background by tracking-in fallout dust and by the accumulation of discarded, contaminated clothing, is considered. Examples show that for a background γ radiation corresponding to 1 R/hr at (H + 7) hr, it would be necessary to accumulate the activity from about 10,000 contaminated persons in a space about 150 ft^2. In terms of the γ hazard from generalized contamination, the build-up of background γ radiation of health installations in reception areas is not likely to be a major problem. (BBB)

51640 RADIOLOGICAL SAFETY OFFICER. **Farr, R. F. (Queen Elizabeth Hospital, Birmingham, Eng.). Radiography, 34: 73-8(Apr. 1968).**

Responsibilities and functions of the health physicist in overseeing safe practices in radiodiagnostic and radiotherapy departments are outlined. He should instruct the staff in the hazards of radiation and how they may be minimized. Student radiographers should be taught the principles of safety along with radiographic technique. Protection measures should be taught at the same time as exposure factors and positioning. The staff must be monitored, and watched that they wear their film badges in the appropriate site, at chest or waist level and under the lead-rubber apron. Personal doses must be recorded, added up each quarter, and the figures preserved for 30 yr. Hospital staff from outside the department, such as nurses and other attendents, who hold patients during radiography also need to be issued a film-badge and the dose recorded. The duty of the safety officer is to ensure that no member of staff assists unduly frequently in this way, and that all members of staff and patients' relatives who assist should be provided with protective clothing and carefully positioned and instructed. The safety officer is responsible for the good condition of the protective clothing. A recommended scheme of administrative organization is given, and instructions to radiographers for routine testing of protective clothing are provided in an appendix. (BBB)

51641 RADIOLOGICAL SAFETY OFFICER IN THE RADIOTHERAPY DEPARTMENT. **Craig, L. M. (Middlesex Hospital, London). Radiography, 34: 13-15(Jan. 1968).**

The duties of radiological safety officers in radiotherapy departments are discussed. The scope of the safety officer's work may include the preparation and cleaning of Ra and arrangements for its distribution to and return from the operating theatres and the wards. Local rules for the use of Ra and other sealed radioactive sources should be specified, made clear to staff personnel, and enforced. Patients who are given radiotherapeutic doses of ^{131}I, ^{198}Au, ^{90}Sr–^{90}Y, and other isotopes should be monitored closely, and reports forwarded to the Radiation Safety Committee. The duties of the safety officer in the radiotherapy department should be, over-all, to ensure that the day-to-day protection measures for the proper working of the department are carried out. Any deviation or untoward circumstance in connection with radiation, particularly of the film badge dosage or of working conditions, which appear unsatisfactory should be reported to the head of the department and the radiological protection adviser. A constant review of monitoring dosage received by all personnel must be kept. The supervisory medical officer should be informed of all new designated persons appointed to the staff. The safety officer should distribute local rules and ensure that all appropriate personnel have read them and have acknowledged their application. (BBB)

51642 TREATY FOR THE PROHIBITION OF NUCLEAR WEAPONS IN LATIN AMERICA. (With Additional Protocols I and II). **London, Her Majesty's Stationery Office, 1968. 20p. 1s. 9d.**

The UK signed Additional Protocols I and II on 20th December 1967. The Treaty and Additional Protocols are not in force. (INIS) (UK)

51643 ANALYSIS OF HUMAN THYROIDS FOR ^{99}Tc. **Sodd, V. J.; Jacobs, B. J. (National Center for Radiological Health, Cincinnati). Health Phys., 14: 593-5(June 1968).**

It has been demonstrated that technetium, as the pertechnetate ion, administered orally or intravenously to humans, will localize within minutes in the thyroid gland similarly to the iodide ion. Very little information is available on long-term localization and retention of technetium in the thyroid gland, since most thyroid technetium metabolism experiments have been done with the short-lived (6 hr) isotope ^{99m}Tc, and nothing has been published on the retention of technetium following continuous administration. Since long-lived ^{99}Tc localizes in the body and is produced in high yield from fission, its radiological health significance to the general population must be considered. In order to determine whether a significant amount of radiotechnetium from fallout is retained by the thyroid, twenty-six glands collected from autopsies of individuals ranging in age from 2 to 88 years were analyzed for ^{99}Tc. Results are tabulated and discussed. (INIS) (UK)

51644 HANDLING THERAPEUTIC DOSES OF RADIOACTIVE NUCLIDES IN A HOSPITAL. Hendee, William R.; Lohlein, Stanley J. (Univ. of Colorado, Denver). Radiol. Technol., 40: 81-4 (Sept. 1968).

Attempts to reduce radiation hazards associated with therapeutic procedures utilizing millicurie quantities of various unsealed radionuclides are discussed. An outline of procedures for control of radiation exposure and contamination of thyroid carcinoma patients treated with ^{131}I is presented. Methods of reducing contamination hazards from the use of ^{32}P and ^{198}Au for treatment of pleural and peritoneal malignant effusions are discussed. (H.L.W.)

51645 ASSESSMENT OF THE AVERAGE $^{90}Sr/Ca$ RATIO IN THE DIET FROM URINE ANALYSIS. Liniecki, Julian; Spodenkiewicz, Teresa (Inst. of Occupational Medicine, Lodz). Nukleonika, 13: 349-60(1968).

The results of $^{90}Sr/Ca$ assays of human urine pooled from adults are reported. The average ratios in 1964, 1965, and 1966 were 26, 22, and 21 pCi/gCa, respectively. To calculate the dietary contamination the alternative $O.R._{urine-diet}$ values of 0.75 and 0.9 were assumed based on the data available from the literature. The problem of the time lag between the $^{90}Sr/Ca$ ratio in urine and diet is discussed on the basis of a kinetic model deduced from independent studies of Sr metabolism. Levels of the dietary contamination assessed in this way are compared with other data on ^{90}Sr in bone (Łódź and New York) and diet (New York), and it is concluded that the assessment of the dietary ^{90}Sr ratio through assays of similar urinary ratios gives consistent results. The accuracy of the estimates seems satisfactory for the purpose of monitoring. (auth)

51646 RADIATION DOSE IN ISOTOPE ENCEPHALOGRAPHY. Hilditch, T. E. (Radiological Protection Service, Belmont, Eng.). Lancet, 2: 573-4(Sept. 7, 1968).

A model is described for estimating the dose of ^{131}-labeled human serum albumin to the human spinal cord. It was concluded that the dose to the surface of the spinal cord, following intrathecal injection of a given activity of ^{131}I-labeled human serum albumin, depends on the volume of the spinal subarachnoid fluid, the half-life of the tracer in the spinal regions, and the effective thickness of the protective layer covering the cord. Considering an extreme case, when the volume of the spinal subarachnoid fluid is only 30 ml., the protective layer is negligibly thin, and the clearance half-life is 24 hours, the β-radiation dose to the spinal cord surface is 24 rads per 100 μCi ^{131}I-human serum albumin administered. If the spinal cord is 0.9 cm in diameter, the average dose is 2.7 rads. The dose to parts of the nerve-roots may be as high as 48 rads. (H.L.W.)

51647 STUDIES ON THE TRANSLOCATION OF CESIUM AND STRONTIUM IONS IN THE THALLUS OF CLADONIA ALPESTRIS. Tuominen, Yrjo (Univ. of Helsinki). Ann. Bot. Fenn., 5: 102-11(1968).

The extent to which the thallus of the dead lichen C. alpestris was able to take up and translocate ^{137}Cs and ^{90}Sr was studied. Silica gel was used as an accelerating factor to investigate whether under natural conditions wind promoted the translocation of these cations. The unexpectedly rapid translocation that was observed seemed, with respect to ^{137}Cs, to fit a diffusion equation in unidimensional form. Silica gel used as a simulator of wind had an accelerating effect on the translocation of both cations. The results of these experiments could be approximately reproduced with a diffusion model. The characteristic difference in the vertical distribution of Sr and Cs ions demonstrated the cation exchange ability of the thallus. The concentration distribution of the Sr ions fit a diffusion model in which the diffusion coefficient passes through a maximum between the base and top of the thallus. Introduction of reflection at a boundary in connection with the results of the lichen simulator experiments made it easier to explain the shape of the curves showing the accumulation of cations at the tops of the thalli and also supported the assumption that translocation of Cs and Sr along the thallus was primarily diffusive in character but complicated by cation exchange, especially with respect to Sr ion. (BBB)

51648 THE ^{90}Sr CONTENT OF MILK AND TOTAL DIET IN BERLIN, 1962 TO 1965. Scheel, H.; Blume, W.; Schoedel, U. Nahrung, 11: 375-80(1967). (In German).

Whereas from 1963 to 1965 ^{90}Sr fallout considerably decreased, the decrease of the ^{90}Sr contamination of milk and total diet was low. The annual mean levels of ^{90}Sr in milk decreased from 16.3 pCi/l in 1963 to 12.2 pCi/l in 1965. During the whole period the ^{90}Sr intake with total diet was on the average about 25 pCi/day for adults and about 10 pCi/day for children of the age of one year. The percentage contribution of milk ^{90}Sr was estimated to be 15 to 20% for adults and about 80% for children. The ^{90}Sr amount taken in with institutional dinner was low (about 10% of the total intake). The daily ^{90}Sr intake was about 10% of the maximum permissible intake that was derived from the recombinations of the ICRP. (auth)

51649 LEVELS OF ^{137}Cs IN NORWEGIAN LAMB AND SHEEP 1964–1965. Madshus, Kjell; Stroemme, Aksel (Norsk Hydro's Inst. for Cancer Research, Oslo. Norwegian Radium Hospital, Oslo). Contract AT(30-1)-3364. Acta Vet. Scand., 8: 71-5(1967). (NYO-3364-18).

The concentrations of ^{137}Cs in meat from lamb in the autumns of 1964 and 1965 and in meat from sheep in the autumn of 1965 were determined. The results are given and discussed with regard to the geographical variations, the decreasing concentrations from 1964 to 1965, and the different concentrations in lamb and sheep. (auth)

51650 AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND AND THE GOVERNMENT OF JAPAN FOR COOPERATION IN THE PEACEFUL USES OF ATOMIC ENERGY, WITH MEMORANDUM OF UNDERSTANDING. London, Her Majesty's Stationery Office, 1968. 7p.

51651 RADIATION PROTECTION NORMS. REVISED EDITION 1968. Paris, European Nuclear Energy Agency, 1968. 49p.

Recommendations for maximum permissible doses to occupationally exposed persons and to the population as a whole are presented. An appendix is included giving maximum permissible doses to various organs of occupationally exposed persons. A table giving maximum permissible concentrations of radionuclides in drinking water and in air inhaled for continuous exposure of occupationally exposed persons is presented. Other tables giving maximum permissible concentrations of mixtures of unidentified radionuclides in drinking water and in inhaled air are presented. (H.L.W.)

51652 A RESPONSE TO "NO KILOVOLTAGE DILEMMA." Pentel, Leon. Oral Surg., Oral Med., Oral Pathol., 24: 364(Sept. 1967).

In a recent article entitled "No Kilovoltage Dilemma" (R. E. Buccholz, ibid., 23: 459(1967)) the author took exception to the present author's (L.P.) statement, in an earlier paper, concerning the reported dose disparity of 65 KVP and 90 KVP radiation. In reply, it is stated that in all studies by L.P. no data approaching equivalence of dose between 90 KVP, 15 mA and 65 KVP, 10 mA radiation were obtained. The work of Richards, cited by R.E.B. in which 90 KVP, 10 mA and 65 KVP, 10 mA were used, was characterized as comparable within the doses required for similar imagery on the same film emulsions. If 90 KVP and 15 mA had been used as an exposure parameter in these studies, the lack of equivalence would have been even more pronounced. References cited, including those of depth-dose data, distinctly indicate no dose equivalence between the two radiation qualities. (BBB)

51653 INVESTIGATIVE STUDIES OF PLASMA TORCH HAZARDS. Powell, Charles H.; Goldman, Leon; Key, Marcus M. (National Center for Urban and Industrial Health, Cincinnati. Children's Hospital Research Foundation, Cincinnati). Amer. Ind. Hyg. Ass. J., 29: 381-5(July-Aug. 1968).

Potential health hazards from a medium output plasma torch used in a biological laboratory were investigated, and some industrial applications of higher output plasma torches were surveyed. Exposures to intense ultraviolet radiation, noise, and noxious gases and fumes were measured. Biological experiments on animals and human skin were performed to evaluate the reaction to ultraviolet energy, and thermocouples were used to quantitate the thermal reaction of skin and eyes produced by the plasma torch. (auth)

51654 SIMULTANEOUS DETERMINATION OF URANIUM, ITS ISOTOPES, AND ALPHA ACTIVITY IN URINE BY MASS SPECTROMETRY. Howard, Olin H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Amer. Ind. Hyg. Ass. J., 29: 355-7 (July-Aug. 1968).

The concentration, isotopic composition, and alpha activity of uranium in urine were determined in one analysis by isotopic dilution and surface ionization mass spectrometry. The isotope ^{233}U was added as an internal standard, and the uranium was extracted with tri-n-octylphosphine oxide for the mass spectral analysis. The complete analysis was obtained on as little as 0.1 μg of uranium. The relative standard deviations were ±1% to ±8% at 10 μg of uranium per liter of urine. (auth)

51655 INTAKE OF RADIOACTIVE STRONTIUM AND CESIUM FROM FOODSTUFFS IN 1965. Csupka, S.; Carach, J.; Petrasouva, M. (Krajska Hygienicko-Epidemiologicka Stanica, Bratislava). Bratislav. Lek. Listy, 47: 641-8 (June 11, 1967). (In Slovak).

The intake of ^{90}Sr and ^{137}Cs through various foodstuffs in 1965 in Czechoslovakia was investigated. The specific activity of ^{90}Sr and ^{137}Cs was determined for the major foods; then, the average daily consumption of these foods was estimated for the inhabitants of Czechoslovakia. The main products contributing to radionuclide intake were flour and cereal, accounting for 55% of the ^{90}Sr intake and 54% of the ^{137}Cs intake. Strontium unit values for the period of observation averaged 31.7 pCi ^{90}Sr per g Ca. Results are compared in a table with those for the USA, USSR, and Great Britain. (TSS)

51656 MINERAL CONTENT OF AQUATIC FOODS. Viswanathan, R.; Bhatt, Y. M.; Sreekumaran, C.; Doshi, G. R.; Gogate, S. S.; Bhagwat, A. M.; Unni, C. K. (BARC, Bombay). Proc. Indian Acad. Sci., 64B: 301-13(1966).

Fifty-three samples of freshwater fish and prawns comprising 20 species from the States of Maharashtra, Gujarat and Bihar were analyzed for their contents of Ca, K, P, Cu and Fe. The 7 samples from Bihar were analyzed, in addition, for U. Significant differences were observed between fish and prawns in regard to Cu and Ca contents in edible portions. Thus, the Cu content of prawns ranged from 4.62 to 13.11 ppM; while in the fish the corresponding range was 0.13 to 3.19 ppM. The U content of the fish samples from Bihar was of the order of 0.2 ppM. Data are also given on the analyses of the water samples and on concentration factors. The concentration factors are discussed with reference to the estimation of MPC of the radioisotopes of the elements in water. (25 references) (Indian Sci. Abstr.)

51657 A PHILOSOPHY IN PLANNING COUNTERMEASURES FOR RADIOACTIVE FALLOUT. Yamagata, Noboru (Inst. of Public Health, Tokyo). Koshu Eiselin Kenkyu Hokoku, 16: 134-9 (Sept. 1967). (In Japanese).

An emergency situation in fallout deposition caused by nuclear tests was analyzed to determine: critical isotope, critical type of exposure, critical food materials, and critical population. It was found that the critical isotope was ^{131}I; fresh milk and cistern water were the critical food materials; and babies and infants constituted the critical population. Although most Japanese bottle-fed babies drank powdered milk, a survey revealed that a little less than 1% of 0- to one-month-old babies drank fresh milk; 3% of four- to six-month-old babies and 30% of six- to 10-month-old infants also drank fresh milk. Most of the infants and babies drank fresh milk and not powdered milk. These fresh-milk-fed babies and infants were considered to be the critical population for whom countermeasures were necessary in the event of an emergency fallout situation. (BBB)

51658 RADIATION PROTECTION IN AGRICULTURE AND THE FOOD INDUSTRY. Ruhnau (M.L.U.A., Krefeld, Ger.). Molk.-Ztg Welt Milch, 19: 1601-2 (Dec. 10, 1965). (In German).

The extent and importance of radioactive fallout for milk and other foods were discussed briefly. In the northern hemisphere the uptake of fallout into foodstuffs was a most important factor. The fractions of fission products derived from contaminated foods and secreted in cow's milk consisted of 5 to 10% ^{131}I/liter, 1 to 2% ^{89}Sr/liter, 0.4% ^{133}Ba/liter, and 6 to 10% ^{137}Cs/liter. In West Germany 20 to 25% and 40% of the radioactive Cs and Sr that was present in food was found in milk. The maximum permissible daily intake of ^{89}Sr is 66 pCi, and for ^{137}Cs it is 6600 pCi. During the first weeks after the initial precipitation of fallout, milk was very highly contaminated with ^{131}I if fresh, green fodder was fed to cattle. In comparison to milk, butter contained 0.01% of the ^{131}I and 2% of the ^{89}Sr. Butter was relatively uncontaminated because most of the fission products were insoluble in fats. At most, only 5% of the ^{89}Sr contained in whole milk was associated with the protein. During manufacture of cheese ~92% of the fission contaminants were removed from the milk. Only a small amount of ^{89}Sr remained after formation of acidic cheeses, because it was removed along with the Ca caseinate complex. Decontamination of milk by ion exchange processes was essentially possible, but was not done extensively, in practice. (BBB)

51659 THE TECHNIQUE OF PRODUCTION OF X RAYS. Jensen, F. Handb. Med. Radiol., 1: Pt. 2, 1-84(1965). (In German).

The general characteristics of equipment used for protection from x irradiation and for controlling the dose of administered irradiation are discussed. These included such items as fluoroscopy timers and diagnostic monitors, dose measurement devices, dose charts, filtration procedures and safety filters, and procedures used to ensure against stray or unwanted irradiation. Working space layouts and devices to assist in proper focussing and regulation of irradiation are discussed. Typical examples of x-ray generators are given, and their use in diagnostic and therapeutic environments is presented. Characteristics and construction of x-ray generators and x-ray tubes are outlined. (BBB)

51660 INTEGRAL DOSE IN HYSTEROSALPINGOGRAPHY PERFORMED WITH FULL-SIZE RADIOGRAPHY AND 70-mm FLUOROGRAPHY. Bang, L.; Kaude, J. (Univ. Hospital, Lund, Sweden). Radiologe, 7: 275-9 (Sept. 1967).

Radiation hazards to women, especially those of childbearing age, undergoing x-ray exposure during examination of the uterus and fallopian tubes with contrast media are reviewed. Integral doses in hysterosalpingography performed with full-size radiography and 70-mm fluorography were measured in 41 patients. In examination with full-size radiography, the mean integral dose was found to be 5.5 Kgrad. The mean integral dose was found to be 5.5 Kgrad. The mean integral dose from 70-mm fluorography was 1.7 Kgrad. An integral dose of 2.4 Kgrad per examination was contributed by fluoroscopy with image intensifier. Due to the low integral dose, 70-mm fluorography should be used in hysterosalpingography of women in fertile age, provided the diagnostic accuracy of the method was adequate. Although integral dose was less important than ovary dose from a genetic point of view, measurements of integral dose should be preferred to control the radiation delivered to a patient. The measurements did not disturb the examination, and could be analyzed in detail from the graphical records produced. (BBB)

51661 MEASUREMENT OF TRITIUM IN VERY HIGH CONCENTRATIONS. pp 152-3 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The problems attendant to the measurement of very high concentrations of tritium are only rarely encountered by biological investigators. They may occur during preparation of tritium-labeled molecules, in certain health physic problems, and in chemistry, physics and industry. Two methods may be used in cases where high concentrations exist; the use of a single phototube in monitoring a liquid scintillation system in such a way that an integral current rather than electronic pulses are recorded, or by measuring the Bremsstrahlung generated by the β particles in matter. In this case, a Geiger-Müller counter is used. (E.R.B.)

51662 MEASUREMENT OF TRITIUM IN PAPER OR THIN-LAYER CHROMATOGRAMS. pp 148-52 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

Analysis of the tritium content of paper or thin-layer chromatograms can be done in a variety of ways including: scanning strips of the chromatogram by gas counters or liquid scintillation counting, counting of individual zones of the chromatogram, elution of the zones (spots) with liquid scintillation monitoring, ashing of the zone and counting, reducing the zone to hydrogen-tritium gas, or by autoradiographic techniques where the weak β particles are amplified by a scintillator. Because of the low energy of the β particles, direct scanning procedures are least efficient; the irregularity of the geometry of the paper or layer further reduces this counting efficiency to below 1%. The highest accuracy and counting efficiency are obtained when individual spots are measured by the combustion or elution technique. (E.R.B.)

51663 PROBLEM OF DOSIMETRY. pp 311-17 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The significance of linear energy transfer in dosimetry is discussed. The importance of considering the ionization density along a single track and the range spectrum of the tracks for appraising the amount of energy absorbed in biological material containing tritium is emphasized. Methods of calculating absorbed doses of tritium are described. A figure is presented to show relative deposition of energy from tritium β particles in spherical volumes containing tritium distributed uniformly. Various aspects

of relative biological effectiveness with reference to standard radiation are discussed. In determining RBE of tritium, different radiosensitivities of cell structures and various types of cells must be considered. It is pointed out that a single maximum permissible burden of tritium in an organism cannot be recommended as generally valid for all labeled compounds. (H.L.W.)

51664 PERMISSIBLE DOSE; HEALTH PHYSICS PROBLEMS. pp 342-7 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The autoradiographic technique for checking the amount of tritium incorporated into a cell is discussed. It is pointed out that proper appraisal of absorbed dose in comparison to a standard radiation must include the low dose rate from the incorporated tritium. Data on toxicity of ^{3}H-thymidine led to the proposal that the tritium β particle is as effective as 250 Kvp x rays. Dose limits for tracer experiments involving somatic and genetic effects on animals and plants are suggested. Maximum permissible dose calculations from the basic recommendations of the International Commission of Radiation Protection and the National Committee on Radiation Protection are discussed. Methods of protection against potential hazards from tritium are described. (H.L.W.)

51665 MEASUREMENT BY GAS IONIZATION. pp 87-100 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The theoretical aspects of gas counting are discussed and the instrumentation involved is described. A discussion of solid and liquid substance counting includes planchet preparation techniques, measurement of double-labeled compounds, and application to paper or thin-layer chromatograms. Gas-counting devices and techniques reach optimal efficiency in tritium studies, and regardless of the state of the substance involved, the tritium must be in the gaseous phase to be accurately counted. Where this extreme accuracy is required, the laborious preparations for gas counting are profitable, but where large numbers of samples requiring only moderate accuracy are to be counted, then liquid scintillation techniques are preferred. (E.R.B.)

51666 INFLUENCE OF GRAZING INTENSITY ON ^{137}Cs LEVELS IN MILK. Burmann, Franz J. (National Center for Radiological Health, Cincinnati). J. Dairy Sci., 50: 1891-6 (Dec. 1967).

The influence of grazing intensity on ^{137}Cs concentrations in cows' milk was studied in three groups of Holstein cows. The first group was included in the main herd, the second group followed the main herd in the same rotation but always a plot behind, and the third group had no access to pasture. A difference based on percent deviation was found in ^{137}Cs levels in the milk of the first and second groups. No significant difference was evident during the rainy period, but a significant difference was observed for the dry interval. The correlation coefficient for the same periods was significant and positive. For both groups a significant positive correlation was also obtained for ^{90}Sr vs ^{137}Cs concentration in milk. The third group, consuming only hay and grain, excreted 9 to 10% of its total intake of ^{137}Cs into the milk. (BBB)

51667 ^{65}Zn AND ^{54}Mn IN ALBACORE THUNNUS ALALUNGA FROM THE WEST COAST OF NORTH AMERICA. Pearcy, William G.; Osterberg, Charles L. (Oregon State Univ., Corvallis). Contract AT(41-5)-1750. Limnol. Oceanogr., 13: 490-8(July 1968). (RLO-1750-23).

Zinc-65 and ^{54}Mn were the dominant artificial radionuclides in the livers of albacore collected along the coast of North America from Washington to Baja, California, during the summers 1962-1966. The concentrations and specific activities of these radionuclides changed considerably during summer, indicating rapid responses to different radioecological conditions. Off Oregon and Washington ^{65}Zn levels, as well as specific activities, in albacore increased markedly during summer months. Association of albacore with the effluent of the Columbia River accounted for this enhancement. The ^{65}Zn concentrations of albacore from southern and Baja, California, were about 10% of those off Oregon and Washington with no seasonal trends evident. Highest radioactivities per gram and specific activities of ^{65}Zn were found late in summer off Oregon. The ^{65}Zn concentrations off southern Oregon at this time were as high as those off northern Oregon near the mouth of the Columbia River, probably because of the southward drift of plume waters coupled with the lag time for accumulation of ^{65}Zn through several trophic levels. Manganese-54 enters the ocean primarily from fallout of nuclear weapons tests. Both the radioactivity and the specific activity of ^{54}Mn in albacore off Oregon and Washington decreased during summer. Thus ^{54}Mn appeared to be more available to albacore in offshore waters than in the nearshore waters. The levels of ^{54}Mn in albacore were rather similar during the years of this study; this was unexpected since all the ^{54}Mn presumably originated from 1961-1962 nuclear weapons tests. (H.L.W.)

51668 RADIATION EXPOSURE OF URANIUM MINERS. PART II. HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, FIRST SESSION, MAY 9, 10, 23, JUNE 6, 7, 8, 9, JULY 26, 27, AND AUGUST 8 AND 10, 1967. Washington, D. C., Joint Committee on Atomic Energy, 1967. 601p. GPO $2.00.

Additional backup and reference material to the hearings held May 9, 10, 23, June 6, 7, 8, 9, July 26, 27, and August 8 and 10, 1967, on radiation exposure of uranium miners are presented. (B.G.D.)

51669 STUDIES OF THERAPEUTIC COMPOUNDS USED AGAINST ORGANISM CONTAMINATION BY UPTAKE OF FISSION PRODUCTS. Slouka, Vl. pp 254-71 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

The therapeutic possibilities in the contamination of the organism by an adsorbed radioisotope of fission products are outlined. The therapy may be successful only when the preparation was administered in time and when bonds of radionuclides were not strong enough. Administration of chelates and colloid ion-exchangers is the most successful. Administration of EDTA is fully indicated in the contamination with compounds of reticuloendothelial type of distribution, from the fission products mostly in isotopes of rare earths, in yttrium, plutonium and other transuranic elements. EDTA significantly decreases the deposition in liver and bone as well. It is not effective in Sr, Ba, and Ra. DTPA proves a better efficacy than EDTA in radioisotopes of rare earths, in plutonium and in the mixtures of fission products where radiostrontium is not significantly represented. DDETA decreases significantly the deposition of radiostrontium in the bones when administered before contamination. The main importance of zirconium citrate (CZ) lies in the fact that when administered in time it is efficient in most radioisotopes of fission products, including radiostrontium. Sodium-hexametaphosphate (HMF) was found to be very suitable in experiments in rats and mice. It decreases the deposition in the bones of most of fission products during first hours after contamination. A small therapeutic range and a relative toxicity is a disadvantage of this compound. Due to various mechanisms of EDTA, CZ, and HMF effects, the effects of their simultaneous combinations were studied. The combination of CZ + HMF was found to be most suitable. These experiments revealed that two mechanisms in HMF occur: the formation of soluble complexes and adsorption of the radionuclide in a portion of molecules HMF, which are in the blood as a colloid. In the second case, HMF is active as a colloid ion-exchanger. The administration of medicaments before irradiation was found effective almost in all radioisotopes, only in EDTA it may come to a faster deposition in the bones. However, this fact can be neglected in the long-term evaluation, since radionuclides penetrate into the bones as complexes, most of them are excreted as complexes, and only a small portion is disturbed and deposited for a longer time in the bones. A synthesis of chelate compounds, which may penetrate into cells can be expected. One of the possibilities seems to be the application of polyaminocarbonic acids the active groups of which can be enzymatically liberated and thus they can be active even in a later administration. This fact is very important from the practical point of view. (C.O.)

Medicine

Refer also to abstracts 50908, 50909, 51152, 51183, 51233, 51264, 51265, 51307, 51311, 51335-51337, 51368, 51439, 51485, 51518, 51533, 51552, 51571, 51589, 51602, 51610-51613, 51636-51641, 51644, 51646, 51875, 51883, 51897, 51899-51901, 51913, 51928, 51930, 51936, 51938, 51943, 51946, 51959-51961, 51969, 51970, 51972-51974, 51977, 51978, 51980, 51993, 51997, 52028, 53052, and 53057.

51670 (ABCC-66-67) ANNUAL REPORT, JULY 1, 1966-JUNE 30, 1967. (Atomic Bomb Casualty Commission, Hiroshima and Nagasaki (Japan)). Apr. 1, 1968. Contract AT-49-Gen-72. 336p. (In English and Japanese). Dep. CFSTI.

Activities of the Atomic Bomb Casualty Commission (ABCC) are reported in relation to administrative activities, community relations, technology and research, advisory committee activities, and conference proceedings. The advisory committees recommended the continuation of the ABCC program as long as results of scien-

tific reliability can be obtained. Research projects continued in the following areas: basic radiation estimates, population studies, genetics, growth and development, mortality, morbidity, and specific diseases or disorders. These studies, dealing primarily with atomic bomb survivors with documented acute radiation symptoms, utilized other groups in the post-exposure population for comparative purposes. Included in this report are the fiscal and physical aspects of the commission's activity as well as the extensive public relations program that is a vital aspect of the commission's program. An extensive appendix is included containing lists of staff members, members of the various study groups, policies and practices of the ABCC, titles of research and technical publications, statistics on various pathology studies, and a list of approved research projects conducted by the commission. (E.R.B.)

51671 (AD–644984) RADIATION PROTECTION BY AUXIN ANALOGUES AND ANTIVIRAL AGENTS. Research Paper. Norman, D.; Schultz, R. D.; Steers, C. W. (Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.). June 1966. Contract PH43-64-865. 26p. (DARL–12). CFSTI.

Although plant growth modifiers were found to be totally devoid of radiation-protective activity, their structural analogues were found to protect male Webster white Swiss mice against lethal doses of ^{60}Co γ radiation. A broad-spectrum antiviral agent, statolon, which alone exhibited no activity, was found to synergize the protective action of certain growth modifying analogs. The possibility of latent virus involvement in radiation damage in a manner similar to bacterial lysogeny is also discussed. (TAB)

51672 (NP–16780(Vol.2)) BIBLIOGRAFIA ONKOLOGICZNA. TOM II. RADIOBIOLOGIA, RADIOTERAPIA, IZOTOPY, CHEMIOTERAPIA, CHIRURGIA, BADANIA BIOLOGICZNE. (A Bibliography of Oncology. Volume II. Radiobiology, Radiotherapy, Isotopes, Chemotherapy, Surgery, Biological Investigations). Skurzak, H.; Rybarska, M.; Gadek, A.; Jasinski, W. (Instytut Onkologii, Warsaw (Poland)). 1967. 350p. (In Polish and English). Dep.

Approximately 1500 references to the literature on radiobiology and radiotherapy of cancer are listed. Author and subject indexes are included. (H.L.W.)

51673 (NYO–3267–5) THERMAL AND EPITHERMAL NEUTRONS IN THE TREATMENT OF NEOPLASMS. Technical Progress Report, May 1, 1967–April 30, 1968. Sweet, William H. (Massachusetts General Hospital, Boston). Contract AT(30-1)-3267. 19p. Dep. CFSTI.

The metabolism, tissue distribution, and toxicity of anion $B_{12}H_{11}SH^{-2}$ were studied in mice. The mechanism by which the boron hydride anion was fixed covalently into tumor tissue is discussed. Immunological studies with $B_{12}H_{11}SH^{-2}$ showed that the γ-globulin fraction from rabbit antiserum to sheep RBC's could be conjugated with the anion without a significant decrease in antibody titer. The computer program MEDIPORT that was developed to obtain the spectrum of neutrons emerging from the portal of the medical therapy facility at the MIT reactor under various conditions of moderation and filtration was used to study moderator configurations and to calculate dose. Thus, adequate means for estimating fast neutron as well as γ dose in neutron capture therapy were established; techniques are described. To investigate the RBE of the neutron beam that entered the medical room and the α particles produced in $^{10}B(n,\alpha)Li^7$ reaction, a monolayer HeLa S 3 cell culture was used. (B.S.L.)

51674 (STI/PUB-120(Vol.3)) ATLAS OF RADIATION DOSE DISTRIBUTIONS. VOL. III. MOVING-FIELD ISODOSE CHARTS. Tsien, K. C.; Cunningham, J. R.; Wright, D. J.; Jones, D. E. A.; Pfalzner, P. M. (International Atomic Energy Agency, Vienna (Austria)). 1967. 200p. IAEA: $15.00; Austrian Schillings 388,-; £5.5.10; F Fr 73,50; DM 60,-.

This volume of the Atlas of Radiation Dose Distributions, Volume III, devoted to Moving-Field Isodose Charts, is confined to dose distributions resulting from simple planar rotation, and is based almost entirely on computed dose distributions. The major portions of the text and graphs illustrate the characteristics of moving-field dose distributions obtained with a ^{60}Co beam of 2.54 cm penumbra at 75 cm source-to-axis distance. This beam is designated the Reference Beam and is used for the purpose of studying the effects of varying geometrical conditions such as arc angle, field size, position of centre of rotation, and shape and size of the irradiated medium. In all cases, the medium is considered to be a homogeneous, unit-density, right circular, or right oval cylinder. Dose distributions for other cobalt beams as well as for other radiation energies are compared to those obtained with the Reference Beam. Part I of this volume contains definitions of terms, an outline of the method of computation using a digital computer, and a study of the effects on dose distributions of changing the physical and geometrical parameters in planar rotation. Illustrative graphs are presented. Part II contains 54 isodose charts in the plane of rotation and 114 plots of dose profiles. Field sizes range from 4 × 4 cm to 15 × 15 cm at the centre of rotation, and the rotation angle from 360° to 120° of arc. (auth)

51675 (TID–24457) GUIDE FOR THE PREPARATION OF APPLICATIONS FOR THE MEDICAL USE OF RADIOISOTOPES. (Division of Materials and Licensing (AEC), Washington, D. C.). Nov. 1965. 28p. GPO $0.45.

Specifications of licenses issued to institutions and to physicians for diagnostic and therapeutic uses of radioisotopes are given. Types of application forms are described and instructions for filing an application are given. A detailed explanation of information to be submitted is presented. The following appendices are included: samples of typical licenses; medical isotopes committee; acceptable training and experience for medical uses of byproduct material; a list of well established medical uses; sample applications; nonroutine medical uses of byproduct material; types of instruments needed for medical programs; information on facilities and equipment and operating procedures to be included with the application; and information for commission approval of treatment or disposal by incineration. (H.L.W.)

51676 RESULTS OF SCINTIGRAPHIC INVESTIGATIONS IN PROGRESSIVE PULMONARY DYSTROPHY. Reichardt, H. P.; Hennig, K. (Medizinischen Akademie Carl Gustav Carus, Dresden). Radiol. Diagn., 9: 307-14(1968). (In German).

Iodine-131 scintigraphic investigations of the lungs were conducted in a number of cases of progressive pulmonary dystrophy. They confirmed marked disturbances of vascularization and perfusion, sometimes better than could be recognized through roentgenography. Pulmonary scintigraphy can thus be suitable in establishing the prognosis in such cases. (auth)

51677 SCINTOGRAPHY IN PULMONARY SILICOSIS. Calabrese, U.; Putti, C.; Galluppi, F.; Raffi, G. F. (Univ., Bologna). Med. Lavoro, 59: 250-64(Apr. 1968). (In Italian).

Lung scintigraphy was carried out in eight patients with pulmonary silicosis. The comparison with the chest x rays and the spirometric data showed a relation between sites of low capture on the scintigram and the presence of silicotic nodules of moderate volume in x rays. It was concluded that the scintigraphy in the study of silicosis allowed a more accurate evaluation of the circulatory damage, which is of prominent importance in the prognosis of the disease. (auth)

51678 LIMITATION OF THE USE OF INERT GASES IN THE MEASUREMENT OF SMALL GUT MUCOSAL BLOOD FLOW. Hamilton, J. D.; Dawson, A. M.; Webb, Joan (St. Bartholomew's Hospital, London). Gut, 8: 509-21(1967).

Rate of elimination of ^{133}Xe from the small intestine of dogs was measured. Blood flow measured from the rate of disappearance of ^{133}Xe out of the tissue depends upon the assumption that diffusion of gas through the tissue is so fast that it does not delay its removal, which is therefore dependent only upon blood flow. In the gut, if the same assumption holds true, then when the gas is dissolved in fluid placed in the gut lumen, the rate of its removal will be proportional to blood flow in the mucosa, and will be unaffected by blood flow in any other part of the gut wall. The values calculated from ^{133}Xe disappearance rates, however, were much lower than those obtained by other methods. Moreover, in experiments altering blood flow by intraarterial infusion of bradykinin and vasopressin, no correlation was obtained between the rate of removal of ^{133}Xe and total small gut blood flow measured by collecting venous effluent. Although the O_2 consumption of the small gut remained constant over a wide range of blood flow, there was no correlation between the rate of disappearance of ^{133}Xe and lumen O_2 tension, which is taken as a measure of mucosal oxygen tension. (BBB)

51679 RADIATION THERAPY. Cuccia, Carlo A. (Wilmington Medical Center, Del.). Del. Med. J., 39: 147-51(June 1967).

The indications and limitations of radiotherapy are reviewed. Supervoltage equipment with its skin-sparing effect, greater depth dose, less integral dose and better general tolerance facilitates delivery of cancerocidal doses of radiation to deep-seated tumors without untoward reaction of the teguments or of the other adjacent normal tissues. The available high energy units have not changed the ratio between the tumor lethal dose and the normal tissue tolerance. They offer the technical advantage of delivering lethal doses of radiation to deep-seated tumors because of the greater penetration of their beams and of the improved systemic tolerance to this type of radiation. Radium therapy offers the advantage of delivering a cancerocidal dose of radiation to a relatively small volume of tissue in a short period of time. It produces only extremely localized minimal reactions, reduced damage to the surrounding normal tissues, and considerable shortening of the overall time of treatment. The γ emitters, such as ^{90}Y, ^{192}Ir, ^{182}Ta,

^{137}Cs, and ^{60}Co are extremely useful for interstitial or intracavitary radiotherapy, and through the use of so-called afterloading technique have considerably reduced the operator's exposure to irradiation. (BBB)

51680 PRESURGICAL IRRADIATION FOR BRONCHOGENIC CARCINOMA. Paulson, Donald L. (Baylor Univ., Dallas). Dallas Med. J., 52: 14-20(Jan. 1966).

The effect of preoperative irradiation on lung tumors was studied in 43 patients after an explanation of the rationale for such radiotherapy. The aims of presurgical irradiation are to limit the extent of the tumor by destruction of cancer cells at the periphery, to produce sclerosis of the vascular bed and sterilize the lymphatics, and to damage the viability of the remaining malignant cells to decrease their ability to implant themselves and grow if disseminated or left behind at the time of surgery. Presurgical irradiation in moderate dosage (3000 R in 10 treatments) converted tumors in the superior sulcus to operable lesions, with prolonged patient survival in some cases. Pathologic examination of the specimens resected 4 to 6 weeks after completion of presurgical irradiation showed a profound alteration in the neoplasms. Grossly, there was a peripheral pseudocapsule and central degeneration. The lymphatics in the extrapleural plane adjacent to the neoplasm became fibrosed and no neoplastic cells could be found. The periphery of the tumor was reduced to a desmoplastic mass so that it was necessary to take sections deep within the lesion to find typical neoplastic cells. In the intermediate zone, scattered cells with pyknotic nuclei could be seen as remains of damaged cancer cells. The pathologic findings indicated marked destruction, fibrosis, and localization of the neoplastic mass by irradiation so that it was possible to carry the line of resection close to the lesion without fear of dissemination or subsequent local recurrence. (BBB)

51681 SYMPOSIUM ON HIGH-ENERGY ELECTRONS, MONTREUX (SWITZERLAND), 7–11 SEPTEMBER, 1964. Zuppinger, A.; Poretti, G. (eds.). New York, Springer-Verlag, 1965. 425p. (In Several Languages). (CONF-640918).

Separate abstracts were prepared on the 101 papers presented in this symposium. Several papers present discussions of electron absorption and dosimetry, several deal with the RBE of high-energy electrons, and the majority of the papers discuss the applications of high-energy electrons to radiotherapy. (E.R.B.)

For abstracts of individual papers see: 51254–51261, 51323, 51335, 51336, 51577, 51580, 51589, 51682, 51687–51698, 51702–51733, 51735–51764, 51883, 51884, 51897–51901, 52489–52492, and 53051.

51682 INTEGRAL DOSE IN ELECTRON THERAPY. Jones, J. C. pp 71-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

It is shown that in electron therapy lower integral doses are produced by electron beams for very superficial tumors. However, as the electrons penetrate beyond the first few centimeters the integral dose increases appreciably when an attempt is made to provide a reasonable uniform dose over a volume beneath the skin. (auth)

51683 EFFECT OF 5-FLUOROURACIL POST-TREATMENT ON UV RESISTANCE OF ESCHERICHIA COLI CELLS. Brozmanova, J.; Varkonda, S.; Sedliakova, M. (Inst. of Biology, Bratislava). Folia Microbiol. (Prague), 13: 221-5(1968).

The effect of 5-fluorouracil (5-FU) and of uracil starvation on the uv sensitivity of E. coli was followed for 60 min after irradiation. The presence of 5-FU caused a significant increase of radioresistance when compared with the control; on the other hand, under conditions of uracil starvation the cells were slightly more sensitive than in the control sample. Synthesis of DNA was markedly inhibited under conditions of uracil starvation and the same effect was observed in the presence of 5-FU. Maximum inhibition of protein synthesis was observed when uracil was omitted from the culture medium and ~50% of inhibition was noticed in samples with 5-FU. The increase of resistance caused by the presence of 5-FU in the 60-min period after uv irradiation could not be explained by prolongation of the sensitive post-irradiation phase. It seemed probable that in the presence of 5-FU conditions were more favorable for repair processes. (BBB)

51684 CONGENITAL THYROTOXICOSIS: CASE REPORT AND RESULTS OF ^{132}I UPTAKE STUDIES. McHardy-Young, S. (Stanford Medical Center, Palo Alto, Calif.); Blackburn, G. J. Endocrinol., 41: 299-300(June 1968).

The readily available, short-lived isotope ^{132}I reduces the radiation exposure to $1/50$ to $1/100$ of that for ^{131}I. Iodine-132 was used in this case to confirm the diagnosis of thyrotoxicosis in a 5-day-old infant. Although there were no previously reported studies of early uptake determinations in the neonatal period with which to compare the findings, the 2- and 4-hr readings of 46% and 72% appeared to be outside the normal range. It was suggested that the use of ^{132}I was a rapid and safe means of assessing thyroid function in the neonate. The mother was clinically thyrotoxic with slight exophthalmos and these findings were confirmed by basal metabolic measurements (+52%). Successful treatment of the infant with stable iodine was carried out. (BBB)

51685 PROTEINURIA IN HIROSHIMA AND NAGASAKI, JAPAN. Freedman, Lawrence R.; Seki, M.; Phair, John P.; Nefzger, M. D. (Atomic Bomb Casualty Commission, Hiroshima, Atomic Bomb Casualty Commission, Nagasaki). Yale J. Biol. Med., 40: 109-30(Oct. 1967). (TID–23912).

This study of 5000 atom bomb survivors and controls was designed to estimate the age distribution of proteinuria, relate this finding to other data from general medical examination, compare the results of successive tests for protein, and look for a possible influence from prior exposure to ionizing radiation. Proteinuria was more common in Hiroshima than in Nagasaki. The rates for men and women did not differ within cities. Age-specific rates of proteinuria were peculiar, peaking in adolescence and old age. Proteinuria was frequently inconstant and usually represented excretion of less than 1.0 g/day of protein. Prior exposure to radiation as measured by distance from the bomb hypocenter was correlated with increased proteinuria rates in 18-yr-old subjects who were in utero at the time of the bombing. Subjects exposed after birth did not show this tendency. It is unsettled whether this was an effect of in utero irradiation and, if so, whether irradiation results in renal disease by increasing the subject's susceptibility to the usual causes of glomerulonephritis or by some more direct mechanism. Persons with proteinuria had higher mean blood pressures and serum urea nitrogen levels than controls and had other findings indicative of generalized cardiovascular-renal disease. Persons with thyroid disease had an increased risk of proteinuria whereas the converse was true of those with a history of treatment for peptic ulcer. No correlation was found between many other factors and proteinuria, including family history of renal disease, socioeconomic status, urinary symptoms, ingestion of medications, physical findings, hemoglobin levels, height, weight, ABO blood groups, audiometry, vibrometry, and serum choiesterol levels. (BBB)

51686 TREATMENT OF SKIN TUMORS WITH ELECTRON IRRADIATION. Jansen, H. (Gemeenteziekenhuis, The Hague). Ned. Tijdschr. Geneesk., 110: 1727-9(Sept. 24, 1966).

Physical and radiobiologic aspects of fast-electron radiotherapy of skin cancer are considered with reference to some clinical results. The important advantage of this type of radiotherapy, i.e., the nearly complete homogeneity of the dose from the body surface to a given depth of tissue so that it is possible to irradiate a tumor homogeneously with a sparing of the sound tissue underneath the tumor is discussed. The electron accelerator used to obtain the clinical results that are reported was an 18-MeV betatron with useful energies between 4 and 18 MeV. (TSS) (BBB)

51687 ADDITIONAL DOSE THROUGH BETATRON NEUTRONS. Frost, Dietrich; Michel, Lothar. pp 156-60 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The additional neutron dose values in tissue produced during irradiation with photons and electrons of a 35-MeV-Betatron are for 35 MeV and FSD = 1.1 m: 9.5 rem/100 rad in case of bremsstrahlung and 0.35 rem/100 rad for electrons. Further dose values are produced by activated tissue. The highest activities in tissue are those of ^{15}O, ^{11}C, and ^{13}N. These isotopes emit low-energy positrons which annihilate in 2 quanta. If absorption of corpuscular-radiation and annihilation quanta is regarded, the additional dose is: 13 mrem/100 rad in case of bremsstrahlung and 0.5 mrem/100 rad for electrons. These doses can be neglected in comparison with the neutron dose values. (auth)

51688 NEUTRON CONTAMINATION OF ELECTRON BEAMS. Brenner, Martin. pp 153-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The neutron dose accompanying the electrons of a 35-MeV Asklepitron betatron was calculated close to the skin in the center of the field and was shown to be less than 3.6 parts per thousand of the corresponding electron dose. (B.G.D.)

51689 PHYSICAL AND BIOLOGICAL DEPTH DOSE CURVES FOR FAST ELECTRONS. Markus, Benno. pp 148-53 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

A biological depth dose curve gives us the possibility to correlate always every point of a physical depth dose curve with the biological effects. In case of fast electrons the effect of a distinct dose, but given in different depths is not the same. Two irradiation possibilities are discussed: irradiation with an equal constant dose in every depth (equal irradiation time), and constant surface dose and different dose in every depth with determination of the dose which gives equal effect as on the surface. Experiments with HeLa and Allium Cepa cells irradiated at different depth in a phantom shows that especially for small doses the RBE is far from unity e.g., an increasing biological effect with increasing material depth is to be expected. Furthermore the efficiency of electrons in a depth corresponding to 30% value of the phantom depth dose curve lies between that of 200 keV x-rays and that of electrons at the surface of the irradiated phantom. The importance on an accurate physical dosimetry is stressed. (auth)

51690 DEPTH DOSE CURVES DETERMINED BY IONIZATION, FILM DENSITY, FERROUS SULPHATE, AND SURVIVAL RATE OF COLI BACTERIA AND DIPLOID YEASTS USING A 20 MeV ELECTRON BEAM. Wambersie, A.; Dutreix, JA.; Dutreix, J.; Tubiana, M. pp 140-2 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Depth dose curves in a 20-MeV electron beam were determined by using physical, chemical, and biological detectors. Measurements were made in Perspex under similar reproducible geometric conditions. (auth)

51691 DOSE DISTRIBUTION OF BETATRON ELECTRON BEAM BY PENDULOUS TECHNIQUE. Ishida, T. pp 126-9 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The application of pendulous irradiation is most effective in cases of post operative irradiation of the breast and laryngeal or hypopharyngeal tumors. Radiation dose distributions of betatron electron beams were made by the pendulous technique on a neck phantom in order to evaluate this technique for irradiation of laryngeal and hypopharyngeal tumors. Fluoro-glass dosimeters were used for these measurements. (B.G.D.)

51692 DEPTH DOSE MEASUREMENTS IN A RADIATION EQUIVALENT MANIKIN. Poretti, Guelfo G. pp 121-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Depth dose measurements carried out with 35-MeV electrons with the Rando phantom marketed by the Alderson Research Lab., Inc., U.S.A. The phantom is an average man, 170 cm tall and 73 kg (if complete with arms and legs), sliced transversely into sections 2.5 cm thick. The phantom is instrumented either by insertion of ion chambers into holes or by film sheets placed between adjacent sections. (B.G.D.)

51693 DEPTH DOSE DATA IN INHOMOGENEOUS MEDIA. Laughlin, John S. pp 108-16 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Depth dose measurements with high-energy electrons in homogeneous and inhomogeneous media for application to radiotherapy planning are discussed. (B.G.D.)

51694 EFFECT OF WEDGE FILTERS, MOULAGES, AND PROTECTION DEVICES IN RADIATION THERAPY WITH HIGH ENERGY ELECTRON BEAMS. Tosi, Gianpiero; Maestro, A. pp 102-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The physical problems involved with the design, construction, and use of filters and protection devices to be interposed across high-energy electron beams in radiotherapy are discussed. Some possible solutions are outlined. (B.G.D.)

51695 DEPENDENCE OF THE DOSE AND DOSE RATE ON THE RELATIVE BIOLOGICAL EFFECTIVENESS OF ELECTRONS. Hagen, Ulrich. pp 168-70 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Theoretical considerations regarding the influence of dose and dose rate on the relative biological effectiveness (RBE) of radiations of different quality are discussed. In general, there is a greater difference in the RBE values in the lower dose range than in the higher one. This has also been found when comparing the effectiveness of fast electrons with conventional x rays of about 200 keV. The most experimental data have shown, that the dose effect curves of fast electrons are steeper than those of x rays, despite the fact that the effectiveness of the electrons is in some experiments lower than one and in others higher than one. The effect of the dose rate on the RBE depends on the reversibility of the radiation damage. In general, radiations of low LET show a higher dose rate dependence than high LET radiations. The difference in biological effectiveness of two radiations of different quality is therefore greater, if the radiation is given in low dose rate than in high dose rate. The experiments with fast electrons have shown, however, that electrons of low dose rate are more effective than those of high dose rate. (auth)

51696 USE OF DECELERATORS IN ELECTRON THERAPY. Bewley, David Kevin. pp 95-7 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of decelerators remote from the patient is discussed, with particular reference to the effect of x ray production in the decelerator. (auth)

51697 DETERMINATION OF THE ISODOSE IN WATER OF HIGH ENERGY ELECTRON BEAMS. Lerch, Pierre; Hoang, H. Tran. pp 92-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Central axis isodose curves were determined using both ionization chambers and photographic emulsions in a plexiglass vessel $42 \times 32 \times 30$ cm with a volume of 40 liters of water. The source of high-energy electron beams was the BBC-Asklepitron 35. (B.G.D.)

51698 A BALANCING CHAMBER FOR STABILIZING THE HOMOGENEITY OF THE ELECTRON FIELD BETWEEN 10 AND 35 MeV. Pettersson, C.; Hettinger, Gunnar. pp 89-91 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

A balancing ion chamber was constructed to define the homogeneity of the electron field at low dose rates when taking isodose curves with fast films. (B.G.D.)

51699 THE INFLUENCE OF NEUROLYTIC AGENTS ON THE ACTIVITY OF SULFUR-CONTAINING RADIOPROTECTORS. Atrelkov, R. B. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Radiobiologiya, 7: 939-40(1967). (In Russian).

White mice of both sexes weighing 18 to 21 g received radioprotectors (150 mg/kg of cystamine, 150 mg/kg of BMEA, 150 mg/kg of AET, and 200 mg/kg of cysteine) 10 to 15 minutes before irradiation with 900 R at 75 to 65 R/min. Cholinolytic agents (5 mg/kg of atropine, 12.5 mg/kg of hexonium, 5 mg/kg of methyldiazil, and 75 mg/kg of dimedrol) were administered intraperitoneally 5 to 10 minutes before the injection of the protectors. None of the cholinolytic agents inactivated the radioprotective properties of the sulfur-containing substances. (JPRS)

51700 THE USE OF ELECTRON BEAMS IN CLINICAL RADIATION THERAPY. Botstein, Charles; Schwartz, George (Albert Einstein Coll. of Medicine, Bronx, N. Y.). Progr. Clin. Cancer, 3: 191-204(1967).

Radiobiological aspects of high-energy electron radiotherapy and techniques for the prevention of tissue injury are reviewed. The change in RBE along the path of an electron as it penetrates tissue is discussed. It appears likely that there is an initial plateau region of RBE extending to the 50 or 60% isodose level, and a 25 to 35% rise in RBE in the terminal portion of the electron path, the region equivalent to the Bragg peak of heavier charged particles. During the usual course of treatment, the skin exhibited pigmentation, dry desquamation, and occasionally some moist desquamation. In a few cases mild pigmentation and subcutaneous induration were still noticeable up to 2 yr after therapy. Patients with breast cancer treated with 30- and 35-MeV electrons and followed for periods of more than 1 yr usually showed a marked radiation pneumonitis resulting in fibrosis. Only one of these five patients suffered from dyspnea on exertion while the others were asymptomatic. The treatment plan for carcinoma of the bladder took advantage of the rapid fall-off of the electron beam. Irradiation of the posterior bladder wall to an adequate tumor dose might produce a severe proctitis, so to improve the dose distribution and to spare the posterior rectal

wall, a rubber balloon in the rectum was filled with 50 ml of water. This brought the bladder closer to the anterior wall while displacing the posterior rectal wall beyond the effective range of the electrons. This prevented any occurrence of diarrhea in these patients. (BBB)

51701 EXTERNAL COUNTING OF ^{85}Sr IN VERTEBRAL FRACTURES. **Alffram, Per-Axel; Lindberg, Lars (Malmo General Hospital, Sweden). J. Bone Joint Surg., 50A: 563-9(Apr. 1968).**

The results of external counting of intravenously injected ^{85}Sr in human subjects with vertebral fractures are reported. The patients were given 50 μCi of carrier-free ^{85}Sr intravenously. External counting was performed over 12 levels of the spine between the seventh cervical vertebral and the sacrum 2 weeks later. The activity value recorded over each counting level was expressed as a fraction of that recorded over the level of the seventh thoracic vertebra in cases with fractures of the thoracic spine, and that of the fourth lumbar vertebra in fractures of the lumbar spine. The activity curves of the spine were compared with normal curves obtained from pooled data of external countings of patients examined for various reasons but without symptoms or roentgenographic signs of spinal disease. As a measure of the activity over the fracture, the peak value over the injured vertebra minus twice the standard deviation of the mean value of the level in the normal curve was used. Increased uptake of ^{85}Sr was regularly found over fractures not older than 6 months. After that, the peak values fell, and practically all fractures after 18 months displayed values within normal limits. (BBB)

51702 COMPARISON STUDY OF IRRADIATION OF TONSILLAR EPITHELIOMA WITH 22 MeV PHOTONS OR 21 MeV ELECTRONS. **Malaise, E. P.** pp 210-13 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

A clinical and statistical analysis of the comparison between the use of photons (22 MeV) and electrons (21 MeV) for therapy of tonsillar epitheliomas was undertaken. The results indicated that the shape of the epithelioma-regression curves for photons and electrons were identical. At 4500 rads, treatment with photon-therapy reduced the size of the tumors to 24% of their initial size while electrontherapy resulted in a 48% reduction. The difference is statistically significant at $P < 0.001$. (E.R.B.)

51703 POST-OPERATIVE IRRADIATION. **Ward, H. W. C.** pp 416-18 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Post-operative irradiation of the chest wall in cases of mastectomy for breast carcinomas and of the neck following excision of the thyroid presents special technical difficulties. In chest wall irradiation, the problem is the treatment of a curved surface to sufficient depth without treating the underlying lung tissues. The ideal technique for accomplishing this is the arcing technique. The problem is similar in the case of neck irradiation where thyroid-bed doses must be sufficient to prevent recurrence of carcinomas while the radiosensitive spinal cord must be avoided. Here again electron beam therapy (15 MeV) using the arcing technique satisfies both criteria. In some cases, large single field techniques are effective. (E.R.B.)

51704 INDICATIONS FROM THERAPY WITH FAST ELECTRONS UP TO 16 MeV. **Becker, Joseph.** pp 418-22 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

When surveying the experiences of 10 yrs in the use of fast electrons from 6 to 16 MeV we were able to presume that the clinical use of fast electrons for treatment of malignant tumors means a definite progress. This special kind of rays in the hands of experienced men represents an improvement in the number of cures compared to the results of the conventional x-ray treatment. Furthermore the number of patients to be irradiated could be increased. For a number of tumor localizations, electron beam-therapy is specially indicated. (auth)

51705 POSSIBILITIES OF SURGERY IN O.R.L. AFTER THERAPY WITH FAST ELECTRONS. **Bozzi, Enrico.** pp 411-16 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Surgery is associated with high-energy electron therapy in one of two ways; after unsuccessful radiotherapy (primary failure or recurrent disease), or in close combination with the program of radiotherapy. The program is planned on the basis of the electron therapy. In cases where 14 and 32 MeV electrons were administered to total doses of 5000 to 10,000 R over a period of six to eight weeks, the surgery was delayed 60 to 70 days following completion of radiotherapy to allow for the highest effects of the radiotherapy to be obtained. In some cases, the planned surgery was eliminated because the tumor (in the larynx) disappeared under the influence of the high-energy electrons alone. Several cases are discussed and the effects of irradiation on the surgical procedures are included. (E.R.B.)

51706 HISTOPATHOLOGY OF TUMORS PRE-IRRADIATED WITH FAST ELECTRONS. **Cottier, Hans.** pp 407-10 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

In discussing the advantages and disadvantages of preoperative irradiation of malignant neoplasms, in particular with fast electrons, the problem of arriving at a correct histological diagnosis is a serious one. While most preirradiated carcinomas can still be recognized as such, the histological evaluation of preirradiated sarcomas, especially those with little or no production of intercellular substance, may encounter considerable difficulties. Some of the criteria helping to detect preirradiated sarcomas are mentioned. (auth)

51707 PRE-IRRADIATION WITH FAST ELECTRONS. **Campana, Luc.** pp 402-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

In accordance with the tumor stage, pre-irradiation is performed in two different ways: operable tumors and biopsies — small doses and a short-time interval; and borderline operable cases and inoperable tumors — high doses and a long-time interval. Because of certain advantages of electrons over photons, high energy electrons were used whenever possible. In general, the surgery and post-operative course has not been changed due to electron therapy. The tumor regression by using electrons and assuming an RBE of 0.7 has proved to be more beneficial than with conventional x rays. The vitality i.e., regeneration of the tumorbed is not significantly disturbed by the use of doses of 6000 R, and tissue transplants are not disturbed in their growth by this dosage. (auth)

51708 TREATMENT BY ELECTRONS OF RECURRENCES AFTER RADIOTHERAPY. **Veraguth, Peter.** pp 398-402 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In French).

See CONF-640918.

When surgical resection cannot be carried out, electron treatment seems to offer the best chance for dealing with a post-radiation recurrence. Neither a previous moist skin reaction nor atrophic changes are an impediment to a second course of curative electron treatment. Necrotic ulcers in the center of such a recurrence sometimes need a longer time to heal. The late trophic changes may be more severe if the total dose exceeds 8,000 to 10,000 rem. The best results are obtained in recurrent skin, breast, and thyroid tumors. The early response of pharyngolaryngeal recurrences is often good, but the danger of soft tissue necrosis is greater than for other tumor localizations. (auth)

51709 BENIGN LESIONS TREATED BY ELECTRONTHERAPY. **Van Vaerenbergh, P. M.; Schelstraete, K.** pp 397-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

While it is an indispensable factor in the treatment of benign lesions, betatron-therapy represents a precious aid in the treatment of a great number of superficial and deep-layered diseases. Without taking into account the favorable tissue-action, the augmentation of the relative tumor-dose without damage to healthy tissue, constitutes sufficient reason to prefer electrons in the treatment of several benign conditions. (auth)

51710 HIGH VOLTAGE THERAPY OF TUMORS IN CHILDREN. **Cocchi, Umberto.** pp 396-7 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Reports on seven cases of tumors in children treated with high-energy electrons are given. One patient with Ewing sarcoma has been free from disease for 3.5 yrs. Out of a total of five patients with brain tumors, two are living 12 and 20 months after treatment of tumors of the brain stem and the pons. (auth)

51711 TUMORS IN CHILDREN. Brun del Re, Sergio. pp 395-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Five sympathogoniomes without metastases were treated postoperatively with electrons. The patients live symptom-free now more than three yrs later. Out of seven Wilms-tumors, three are free of symptoms after postoperative treatment. The preoperative treatment should be recommended in these cases. (auth)

51712 TREATMENT RESULTS OF LYMPHONODULAR METASTASIS. Schoen, D. pp 393-4 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Of 212 cases of lymphonodular metastasis 21% did not respond to electron therapy at all. In those cases with satisfactory results at first, 27% were found to have a recurrence within six months. The high percentage of failures of the stated electron therapy within the neck, the supraclavicular region, and the groin is considered to be due to the fact that no higher energy than 16.2 MeV was available. (auth)

51713 TREATMENT OF LYMPHATIC METASTASIS BY ELECTRON THERAPY. Veraguth, Peter. pp 391-3 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In French).

See CONF-640918.

As with other types of high energy treatment, electron therapy is in many cases able to sterilize lymph nodes metastases. Because of the good tissue tolerance, high tumor doses (7000 to 9000 R) may be employed. Several techniques are suitable (single field using varying energies; convergent fields; opposite tangential fields or in combination with x rays). The complete disappearance of the lymph nodes occurs sometimes only after the skin reaction has faded. Finally, some special indications for electron therapy are discussed. (auth)

51714 BRAIN-TUMOUR. Zuppinger, Adolf. pp 389-90 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Results of preliminary investigations of high-energy electron-therapy of brain tumors revealed little difference between the effects of electrons and conventional x rays. Comparison with 30 MeV x rays showed more promise. When electrons were administered in total doses of 7000 to 7500 R over a 40 to 50 day period, the incidence of recurrence and number of tumors not influenced by the treatment was high. The improvement in response with improved technique and the low incidence of side effects from electron therapy seem to indicate eventual application of this treatment for brain tumors. (E.R.B.)

51715 SOFT TISSUE SARCOMAS. Zuppinger, Adolf. pp 388-9 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Over a period of five yrs, 20 cases of soft tissue sarcomas were treated by electron-therapy. Using 31 MeV electrons administered at doses of 6000 to 8000 R over a four to six week period, curative treatments were received by 15 patients, 11 patients are symptom free, and two patients died of metastases (both due to factors other than therapy). The treated tumors included fibro-, spindel-, leio-, lipo-, and polymorphcellsarcomas. Electron-therapy of five cases of synoviomas resulted in four of the patients being free from disease four to five yrs after treatment. The fifth patient was free from disease locally, but died of metastases. (E.R.B.)

51716 SOFT TISSUE SARCOMAS. Hellriegel, Werner. pp 383-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The comparative examination of electron-treated tumors of the soft tissue (2.2.9.) shows better results than with 200 kV x rays. (auth)

51717 BONE TUMORS. Brun del Re, Sergio. pp 381-2 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Osteogenic sarcoma seems to be a favorable localization for electron beam therapy. Out of nine patients who were observed for more than three yrs, two are free from disease and two developed local recurrences. Further attempts are recommended. (auth)

51718 IRRADIATION OF THE CERVICAL CARCINOMA DURING PREGNANCY, BY MEANS OF AN ELECTRON BEAM APPLIED TRANSVAGINALLY. Cova, Pierluigi; Maestro, A. pp 378-80 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Report of a case of squamous cell carcinoma of the cervix in pregnancy treated with electron therapy, caesarian section and Wertheim is presented. Mother and child are in good health eight yrs after treatment. Description of a combined high voltage x ray and electron therapy with reduction of radium dosage in advanced cervix carcinoma is given. (auth)

51719 PRELIMINARY REPORT ABOUT ELECTRONTHERAPY OF THE TUMOURS OF THE VULVA. Minet, Pierre; Chevalier, Ph.; Closon, Jacques; Garsou, Julien. pp 376-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

A preliminary report is presented on the effectiveness of electron-therapy of vulvar tumors. In the case of primary tumors, complete sterilization was possible with high-energy electrons. Combination of electron-therapy with surgery resulted in extremely low recurrence rates (25%) all of a local nature, and one-half of which (12.5%) were the result of low dosage and limited field errors in therapy. Long-term results of electron-therapy of vulvar carcinomas are not yet available. (E.R.B.)

51720 CLINICAL ASPECTS OF THE ELECTRON THERAPY OF VULVA CARCINOMAS. Oberheuser, Friedhelm. pp 372-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Electron beam therapy of vulvar carcinomas must be performed with large fields, also in small tumors. Doses of 4500 to 5400 R with 12 to 16 MeV 300 R single doses are necessary. The same doses are applied to the inguinal region. In 54 patients, five-yr results of 47% were achieved even though more than 50% of the patients belonged to stage III and IV (Huber Classification). (auth)

51721 PENIS CARCINOMA. Zimmerli, Bernhard. pp 371-2 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Cancer of the penis can be irradiated by high-energy electrons with a good chance of cure. 7500 to 8500 R in four to six weeks are necessary with 30 MeV electrons. Surgery is only necessary in the case of failure of radiation therapy. (auth)

51722 RECTAL AND ANAL TUMORS. Graf, Hugo. pp 364-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Twenty-four tumors of the rectum and three of the anus were treated with electrons. The rectum tumors were generally treated also with 30 MeV x rays because of the steep fall in the dose in the case of electrons. The regression of the tumors is better than with conventional x rays and with 30 MeV x rays alone. (auth)

51723 TREATMENT OF THE TUMOURS OF THE BLADDER BY MEANS OF HIGH ENERGY ELECTRON AND ROENTGEN BEAMS. Cova, Pierluigi; Maestro, A.; Confalonieri, A.; Tosi, Gianpiero. pp 358-63 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of high-energy electrons (30 MeV) in combination with x-ray beams was effective in the treatment of bladder carcinomas. During the course of therapy the maximum doses obtainable are 6700 R to the bladder and 4500 R to the lymphatic chains. These doses cannot be readily increased, and any reduction will have to be at the expense of the electron beam. Use of electron beams of 32 MeV or greater could eliminate the need for combined x rays in the treatment. This would increase the dose on the lymphatic chain, give greater protection to the intestine, and reduce the damage incurred by the soft tissue crossed to reach

the focal sites. The side effects of the combined therapy are discussed. (E.R.B.)

51724 TWO YEARS EXPERIENCE WITH CARCINOMA OF THE BLADDER. Botstein, Charles. pp 356-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Although no striking cure rates were obtained in high energy electron (35 MeV) therapy of bladder carcinomas, it was determined that the patients withstood the therapy better than in cases of conventional radiotherapy. The cure rate is low for all types of therapy, but with electron-therapy excellent palliation was obtained without any side effects. Fractionation of the 4500 R to 7200 R doses over a seven to 10 week period produced only mild skin reactions. (E.R.B.)

51725 TUMOURS OF THE INTESTINE. Zuppinger, Adolf. pp 355-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of 31 MeV electrons alone or in combination with 30 MeV x rays results in the shrinkage of intestinal tumors. The extreme radiosensitivity of the mucosa limits the use of radiation for therapy to highly sensitive tumors such as sarcomas. Curative therapy should not be tried as a rule because of the probability of radiation sequelae, but preoperative treatment should increase the results of surgery. Several cases are mentioned where preoperative electron therapy was successfully employed. (E.R.B.)

51726 CLINICAL ASPECTS OF THE ELECTRON IRRADIATION OF MAMMA CARCINOMAS. Oberheuser, Friedhelm. pp 348-50 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

In breast cancer, electron beam-therapy allows intensive irradiation of the region of the primary tumor and the lymphatic outflow as well. The irradiation technique is simple. The total results seem to be slightly better than with conventional x ray. Special attention must be drawn to lung fibrosis, barrage of the lymph vessels, and bone fractures. (auth)

51727 EXPERIENCE WITH ELECTRON IRRADIATION OF BREAST CANCER. Chu, Florence C. H. pp 343-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of electrons for the treatment of mammary carcinomas permits easy manipulation, convenient adjustment of penetration depth, and satisfactory dose distribution at the cancer site. Supervoltage x-ray therapy affords basically the same advantages, but increases the probability of lung complications. The incidence of other side effects of radiotherapy, including pneumonitis and fibrosis, was extremely low with electron-therapy. Skin reactions were not excessive at doses up to 4500 rads administered in four weeks, and usually healed themselves without difficulty. (E.R.B.)

51728 THERAPY OF BRONCHIAL CARCINOMAS. Schumacher, Werner. pp 338-43 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The dose distribution in the mediastinum with two opposing fields is more favorable with 35 MeV electrons therapy than with high-energy photons, ^{60}Co teletherapy, or conventional therapy. In inoperable bronchogenic carcinoma the results of three years experience on 500 patients are better than with conventional therapy. One year after treatment, 50% of the inoperable cases are still living. The high-energy electron beam therapy leads, in inoperable cases stage II, to the same results in the survival rates as the surgical therapy in operable cases. First results of the electromagnetic lens therapy in lung lesions with metastasis in the mediastinum show the possibility of curative radiation treatment without fibrosis in the normal lung tissue. Treatment with high-energy electrons is well tolerated. Most of the patients gain weight during therapy. The teamwork between clinician and practitioner is an important factor. In two mouths following therapy in some patients a radiation pneumonia had to be treated with antibiotics, cortisone, and calcium. The results of therapy are dependable from the follow up treatment. Lung abscesses, haemoptysis, and tuberculosis are no contraindication for electron beam therapy. Lung tissue tolerates high single doses of 1500 rad two times in an interval of a week from two fields without side reactions in palliative treatment of progressive cases. (auth)

51729 ELECTRON THERAPY OF MALIGNANT STRUMA. Becker, Joseph; Kaercher, K. H. pp 335-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Malignant tumors of the thyroid are a special indication for radiological treatment with fast electrons. The best results are obtained with the combination of surgery and irradiation. Treatment with fast electrons affords protection of the normal tissue, especially of the spinal cord. The five yr survival rate improved considerably after introduction of fast-electron therapy. (auth)

51730 LARYNX. Rennaes, Selmer. pp 333-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of electrons for treatment of larynx cancer is under investigation. No significant advantage over x-ray treatment has been established, but considerable evidence is being accumulated with regards to electron doses and post-treatment complications. It was determined that maximum daily doses of 300 R with total doses up to 8000 R reduced the incidence of necrosis in the irradiated area. (E.R.B.)

51731 RESULTS OF THE ELECTRON THERAPY OF LARYNX CARCINOMA. Brun del Re, Sergio. pp 330-2 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

With curative electron-therapy, good results were achieved in 19 cases of advanced laryngeal cancer that would have had a poor prognosis with conventional x rays. Only two local recurrences were observed in an observation time of one to six yrs. In recurrences after irradiation the prognosis is not good, but two patients out of six treated are free of disease more than one year later. (auth)

51732 RADIOTHERAPY OF LARYNGEAL TUMOURS BY MEANS OF HIGH ENERGY ELECTRON BEAMS. Cova, Pierluigi; Maestro, A.; Tosi, Gianpiero. pp 325-30 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Tumors of the larynx respond to single field therapy using high-energy electrons. The energy of the electrons used varies according to the location of the tumor and the thickness of the underlying soft tissues. In the case of chordal tumors, convergent beam therapy is more effective than single field therapy because of the ability to provide high target doses along with lower doses to surrounding tissues. Maximum doses for electron therapy are limited to 7500 to 7800 R in order to eliminate skin reactions. (E.R.B.)

51733 HYPOPHARYNX CARCINOMA. Hellriegel, Werner. pp 321-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

Only advanced hypopharyngeal cancers were irradiated because of lack of experience. The three year survival rate was raised from 14% to 28% by use of electrons. The tumor dose was always 6000 R of 25 to 30 MeV from two lateral fields. Field size was 10 to 12 cm. (auth)

51734 INVESTIGATIONS ON THE APPRECIATION OF THE PROBLEMS OF THE RADIOLOGICAL-CYTOSTATIC COMBINATION TREATMENT. I. Ringleb, Dietrich (Justus-Liebig-Univ., Giessen, Ger.). Strahlentherapie, 135: 597-601(May 1968). (In German).

Problems involved in the combined radiological-cytostatic therapy of neoplasms are reviewed. The concept of combined treatment and generalities on the method are discussed. Observations on changes in the weight of the testicles of mice after x ray, endoxane, and combined treatment are summarized. (J.S.R.)

51735 IRRADIATION RESULTS WITH 35-MeV BETATRON FOR TONGUE BASE TUMORS. Lissner, J. pp 316-21 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The results of irradiation of tongue base tumors treated with conventional x-ray therapy and with the 35 MeV Betatron are compared. The comparison shows no marked difference between these two radiological methods regarding the five years surviving rate, but the reduction of tumor size and lymph nodes happens earlier when using Betatron therapy. The other comparison regarding the treatment with 35 MeV Photons and 25 or 30 MeV fast electrons shows no difference regarding the five years surviving rate as well. Nevertheless there are differences in skin reactions. (auth)

51736 TREATMENT OF THE MESOPHARYNX WITH THE ELECTRON BEAM. Tapley, Norah V.; Fletcher, Gilbert H. pp 309-12 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Lesions of the mesopharynx that were treated with the electron beam during a 15 month period are presented in tabular form. It is found to be of unique benefit in the following situations: in the treatment of asymmetrical, well lateralized lesions of limited volume with a single field or with the addition of an intraoral cone for tumor dose build-up; in tonsillar area lesions with minimal soft palate or tongue extension as combined treatment with high-energy photon radiation when a greater depth dose is required, when a severe skin reaction is anticipated, or when interposed bone may decrease the depth dose; and in lesions arising in the base of the tongue or in extensive lesions with base of tongue involvement as boost treatment using the submental approach. In 12 patients treated to a tumor dose of 7000 to 8500 rads, the regression and control of disease thus far are encouraging. (auth)

51737 CLINICAL OBSERVATION OF TONGUE CANCER TREATED WITH HIGH ENERGY ELECTRONS. Kimura, Shuji; Ishida, Tetuya; Kondo, Kenji. pp 305-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Electron therapy is as effective as radium therapy, and the choice of the treatment should be based on the tumor. The superiority of the electron therapy, however, is impressive in such cases as lymph node metastasis, infiltrated tumor along the mandible bone, tumor near the base of the tongue, and lesions inaccessible for homogeneous radium needle implant, in all of which radium needle implantation is difficult to carry out. In addition, electron therapy reduced the burden of the patients to a noticeable degree. As for electron therapy, intracavity irradiation is essential at present and the difficulty of technique in some cases must be overcome. (auth)

51738 ELECTRON THERAPY OF CANCERS OF THE BUCCAL CAVITY. Bataini, J.; Ennuyer, A. pp 301-3 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In French).

See CONF-640918.

Fifty cases of cancer of the buccal mucosa were treated with fast electrons. Only 15 cases were available for one year followup out of which 12 cases could be retained and analyzed. One cancer of the ginginva of the upper jaw is doing well, as well as seven cases of cancer of the gingiva of the lower jaw that extended to the retromolar trigone. Three of them had rather extensive bone involvement. Four cases of cancer of the cheek mucosa were also treated with success. The complications in this series of 12 cases were practically nonexistent. The effectiveness of fast electrons in the treatment of cancer of the gum and cheek mucosa as well as in cancer of the retromolar trigone and floor of mouth is demonstrated. Cancer of the mobile portion of the tongue should continue to be treated by interstitial radium therapy. (auth)

51739 THE TREATMENT OF THE TUMOURS OF THE MAXILLARY SINUS, ETHMOID, AND HARD PALATE BY MEANS OF HIGH ELECTRON BEAMS. Cova, Pierluigi; Maestro, A.; Tosi, Gianpiero. pp 299-301 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Tumors of the maxillary and ethmoid sinuses were effectively treated by a combination of surgery and high-energy electron beams (28 to 30 MeV for the ethmoid, and 20 to 25 MeV for the maxillary sinus). Tumor sensitivity to the electrons was good while damage to healthy tissue was maintained at a minimum. Doses of 11,000 R in a 10 week period were tolerated in this respect. (E.R.B.)

51740 DOSE DISTRIBUTION PATTERNS WITH ORTHOGONAL BEAMS OF ELECTRONS AND WEDGE FILTERS IN THE TREATMENT OF TUMOURS OF THE MAXILLARY ANTRUM. Minet, P.; Chevalier, Ph.; Garsou, J. pp 295-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Tumors of the maxillary antrum can be effectively treated using two orthogonal beams of electrons. Dose distribution, using 34 MeV electrons, is excellent in the tumor area, however, the oblique incidence of both beams induces two heavily irradiated areas in the brain and the heterolateral eye. Wooden wedge filters were constructed that effectively reduced the dose to areas outside of the target zone, while retaining maximum dosage to the maxillary antrum. (E.R.B.)

51741 RADIOTHERAPY OF TUMOURS OF THE NASOPHARYNX BY MEANS OF HIGH ENERGY ELECTRON BEAMS. Cova, Pierluigi; Maestro, A.; Tosi, Gianpiero. pp 293-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The successful radiotherapy of tumors of the nasopharynx using high-energy electron beams is reported. The use of lateral opposite field therapy techniques is superior to conventional x- or γ-ray therapy because the negligible exit-doses encountered with electrons reduce skin damage to minimal. The condition of the pharyngeal mucosa following electron beam therapy was moist, as opposed to the dry painful condition of the mucosa observed after x- or γ-ray therapy. (E.R.B.)

51742 PAROTID TUMORS. Zimmerli, Bernhard. pp 288-90 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

On the basis of the favorable results using electrons on parotid tumors, it is believed that electron beam-therapy is indicated for most parotid tumors. The primary malignant tumors as well as the large mixed tumors should be subjected to electron-therapy. The small mobile mixed tumors should be treated initially with surgery. The facial nerve should no longer be sacrificed in surgical treatment. Out of 19 cases with a one to six yr follow up, 16 cases are free from local disease. Two of the local recurrences were due to a tumor under-dosage, the third case showed a tumor growth at the margin of the irradiated area. (auth)

51743 EYE METASTASES: RADIOTHERAPY WITH ^{60}Co AND HIGH ENERGY ELECTRON BEAMS. Cova, Pierluigi; Maestro, A.; Tosi, Gianpiero. pp 287-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The use of ^{60}Co γ rays and high-energy electron beams for therapy of eye metastases is discussed. The importance of treatment planning to ensure the safeguarding of the crystalline lens and the cornea to avoid cataracts is emphasized. Several cases are reported in which opposing beam therapy was successfully used employing a lateral orbital field. Neither conjunctivitis nor cataracts were observed in post treatment examinations. Skin reactions were limited to marked erythema. (E.R.B.)

51744 ELECTRON BEAM TECHNIQUE FOR INTRAORBITAL TUMOURS. Hultberg, S.; Walstam, R.; Asard, P. E. pp 283-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The special properties of the electron beam are utilized in a method developed for irradiation of tumors in the orbita. The technical details are described and reports given for the patients treated up to the present. (auth)

51745 TREATMENT OF CANCER OF THE LIP WITH HIGH SPEED ELECTRONS. van Vaerenbergh, P. M. pp 281-2 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

In the small regions of the lips, radium-needling and radiotherapy produce favorable results. Electron-therapy probably leads to a better tolerance of the healthy tissue. In extensive primary cancer of the lip electrons are preferable, they allow restitution that can only be reached by other techniques with great difficulty. In recurrences of lip cancer after previous irradiation the chances of cure with radiotherapy are slight. Nevertheless favorable results can be obtained in some cases with high-energy electrons. (auth)

51746 MYCOSIS FUNGOIDES. Ward, H. W. C. pp 278-80 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

The radiotherapy of mycosis fungoides, a superficial fungal disease of the skin, using electrons is superior to the former method using x rays because of the sharp reduction of dose at depth in tissue. Thus the use of electrons results in a much lower integral dose to the patient. The use of 2.5 MeV electrons for whole-body radiotherapy of the disease was found to be superior to the use of higher energy electrons passed through carbon decelerators. The difference lies again in the integral dose, it being lower by the former method (2.5 MeV). (E.R.B.)

51747 ELECTRON THERAPY OF MALIGNANT MELANOMAS. Weitzel, G. pp 270-1 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).
See CONF-640918.

The effects of fast electrons on malignant melanomas is discussed in relation to the disease-free survival data of the treated patients, in relation to the influence of pre- and post surgery, and in relation to the incidence of metastases. In all respects, the application of electron therapy improved the regression rate of melanomas, increased the disease-free survival time with and without local metastases, and was a beneficial adjunct to surgery in treatment of the tumors. (E.R.B.)

51748 DILUTE CUTANEOUS AND CUTANEOMUCOUS EPITHELIOMAS TREATED BY ELECTRON BEAMS FROM THE BETATRON. Ennuyer, A.; Bataini, P. pp 267-70 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In French).
See CONF-640918.

The immediate results of 37 cases of advanced skin cancer, many of them having been already treated several times, are presented. Most of the cases received 6,500 to 8,000 R given in 30 to 40 days, the doses sometimes reaching 9,000 R in 50 days. (auth)

51749 INHOMOGENEOUS TREATMENT PLANNING. Laughlin, John S. pp 262-7 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

The presence of low or high density materials (relative to unit density) in the radiation field has a profound effect on electron dose distribution. In relation to this, procedures have been developed that take into consideration, during the course of treatment planning, the inhomogeneity of the human body. In low density tissues such as lungs, there is an increase in absorbed dose due to decreased attenuation; while in high density regions such as here, dose decreases due to increased attenuation, and dose elevations due to scattering must be considered. The steps involved in correction of isodose distributions for inhomogeneity in the body are discussed. (E.R.B.)

51750 CHANGE OF THE IRRADIATION RHYTHM. Schumacher, Werner. pp 258-60 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).
See CONF-640918.

The change of the irradiation rhythm is effective in using high-energy electrons. With high single doses the tumor dose can be reduced. In the reported cases it was possible to get, with 500 rad doses twice weekly, the same results as with a tumor dose of 6000 rad, as much as three times 350 rad, and a total dose of 7500 rad. Using a single dose of 1000 rads once a week the tumor dose is about 4000 rads. In deep lying tumors (bronchogenic carcinoma, carcinoma of the esophagus) the radiation therapy from two opposing fields with single doses of 1500 rads, 2nd radiation after a week, and 3rd radiation two weeks after the 2nd radiation showed a good regression of the tumor. This therapy in palliative cases was well tolerated. The patient does not develop radiation sickness. It is important to follow up the patient and to treat the radiation pneumonia that is seen in one third of the patients. No tumor cells were found in control bronchoscopy six weeks after therapy. This rhythm with radiation three weeks after a high single dose increases the effect on the tumor because in this time the reaction with inflammation gives a better oxygenation and nutrition of the tumor tissue. In cancer en curasse it seemed to be the method of choice. With high single doses it is important to give only two doses from one field. (auth)

51751 SANDWICH AND GRID TECHNIQUES. Ovadia, Jacques. pp 251-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

During the course of treatment planning for high-energy (15 to 35 MeV) electron therapy, it is necessary to determine whether the tumor in question is entirely superficial, lying near one particular skin area and requiring therapy from one direction only, or centrally located to the extent that different areas of the tumor can be reached through opposite areas of the body. In the former situation (superficial tumors) the use of grids can spare the skin during high-dose therapy. In the case of deep tumor therapy, the sandwich technique (opposing beams front and back) is recommended. The fact that the depth dose decreases as energy increases permits this sandwich technique with electrons by eliminating entirely the exit dose. (E.R.B.)

51752 MULTIPLE FIELD TECHNIQUE. Ward, H. W. C. pp 248-50 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

Application of multiple field techniques for electron therapy have met with only limited success. X-ray therapy is far superior to electrons for this cross-firing technique suitable to deep tissue therapy. It is suggested that electron-therapy of curved surfaces, either a single field or an arcing technique are preferable to multiple field techniques. Since the accelerator can not be arced around the patient, it is necessary that rotating chairs or tables be installed in electron therapy facilities. (E.R.B.)

51753 MULTIPLE FIELD TECHNIQUE WITH ELECTRON BEAMS UP TO 24 MeV. Tsien, Kia-chi. pp 245-7 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

The value of electron beam therapy lies in the ability to regulate the energy of the electrons in such a way that penetration up to several centimeters can be achieved, while the dose to surrounding tissue is minimal. This advantage however, diminishes rapidly as the target area becomes more centrally located in the organism. It is virtually impossible, even by opposing beam therapy to obtain sufficient dose concentrations at those depths in tissue. Problems of accurate dosimetry are also compounded in deeper tissues. (E.R.B.)

51754 ONE FIELD TECHNIQUE. Bompiani, Carlo. pp 242-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

Owing to the favorable dose distribution, the high energy electron beams are an ideal tool for single field irradiation of lesions on or near the body surface. Dosimetric studies have shown that many physical and technical factors modify the dose distribution in the tissues. The most important factors are energy of the beam, field size, type of collimator, use of scatterers, and the presence of bone or air cavities in the body. In several cases the dose distribution for the treatment of superficial or irregular lesions can easily be improved by the use of plastic absorbers, decelerators, or wedge filters. (auth)

51755 HISTOLOGY AND RADIATION SENSITIVITY. Hellriegel, Werner. pp 230-5 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).
See CONF-640918.

A review of the sensitivity of the different tumor types shows the greatest differences in sarcomas, where the differentiated fibro-, lipo-, and chondrosarcomas need 7000 R and more. Undifferentiated carcinomas need at least 5000 R, the differentiated one at least 6000 R. Brain tumors need at least 5000 R. (auth)

51756 DEPENDENCE OF THE RADIATION EFFECT ON THE INDIVIDUAL AND TOTAL DOSE AND ON THE ENERGY. Schoen, D. pp 225-30 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).
See CONF-640918.

The rates of mild and severe erythema, epitheliolysis, and ulceration of the skin following electron therapy of 555 tumor localizations are reported. The influence of preceding irradiations with common x rays or high-energy electrons, the mean daily dose, the total dose, the energy, and the irradiation-free interval in

case of split-course technique on the reaction of the skin and mucous membrane are examined. The reactions of scars and intertriginous areas are described. The threshold doses with standard deviation are mentioned. (auth)

51757 DAMAGE IN NERVOUS TISSUE AFTER RADIOTHERAPY WITH HIGH-ENERGY ELECTRON BEAMS (ONE CASE). Cova, Pierluigi; Maestro, A.; Tosi, Gianpiero. pp 222-4 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

A clinical case is described in which a woman was treated post operatively with high-energy electrons for a meningioma located in the sphenoid. Three yrs after therapy a large necrotic area was removed surgically from the base of the temporo-frontal region, however, tumor regression was complete from the time of radiotherapy. The necrotic growth was a result of the high doses (11,000 R) of electrons used, though the critical dose range exceeds that for ^{60}Co or ^{137}Cs γ-therapy. (E.R.B.)

51758 DEPENDANCE OF THE BIOLOGICAL EFFECT ON RADIATION FREQUENCY. Kuenkel, Hans A. pp 175-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Experiments are described in the field of ultrafractionation using a betatron to irradiate embryos of Drosophila melanogaster in different stages of development and under various conditions. (B.G.D.)

51759 TIME FACTOR DEPENDENCE OF THE BIOLOGICAL EFFECTIVENESS ON THE INDIVIDUAL DOSE. Kepp, R. pp 172-4 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

There is a different protraction effect in irradiation with classical x rays and with fast-electrons. With fast-electrons, the protraction effect is brought about within higher dose rates than with conventional x rays. The biological effect of electrons from the betatron also depends on the fact that it is a pulsing radiation. Based on our own clinical experience in therapy with fast-electrons, protraction causes an increase of electivity within the range of the dose rate. The latter is of no importance in the case of conventional x rays therapy. (auth)

51760 GENERAL RADIATION REACTIONS. Schoen, D. pp 206-10 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

In 276 patients who were irradiated with 7200 ± 3400 R during 24 ± 7 days by means of high energy electrons (12.8 ± 3.9 MeV), only 1.1% complained of an alteration of their general condition; and in 101 patients 6% acquired granulocytopenia. In cases of preceding or simultaneous irradiation with common x rays the rate of granulocytopenia was significantly higher. Cytostatic therapy was not hampered by electron therapy. All reactions depend on the height of the integral dose given, which in electron therapy is determined by the useful beam and the leakage radiation from the betatron head. From the standpoint of the integral dose and homogeneity of dose distribution only electron irradiations up to 6 cm focal depth are promising. (auth)

51761 LATE REACTIONS. Biagini, C. pp 204-6 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Observations of the occurrence of late effects on patients submitted for treatments for superficial or semiprofound lesions with electrons from a betatron with maximum energy of 15 MeV are presented. Typical reactions, physical factors, and biological factors are considered. (B.G.D.)

51762 SKIN AND MUCOUS MEMBRANE REACTIONS. Ward, H. W. C. pp 200-3 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The effect of dose fractionation on the severity of skin and mucous membrane reactions during electron therapy is discussed. (B.G.D.)

51763 SKIN AND MUCOUS MEMBRANE REACTIONS. Schumacher, Werner. pp 198-200 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The difference in the sensitivity of the tissues in relation to the energy of the electrons is explained by a different RBE. Up to 15 to 18 MeV it is in the same range as in conventional x rays and diminishes with increasing energy. Moist desquamation of the skin arises in energies of 15 MeV with 5000 to 6000 R whereas with 35 MeV 10,000 R are needed for the same reaction. The observation of the individual sensitivity is considered very important. (auth)

51764 EARLY REACTIONS WITH ELECTRON THERAPY. Weitzel, G. pp 189-98 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The early reactions of the skin, the mucosa, and the subcutaneous tissue, that can be observed under treatment with fast electrons of a 15 MeV betatron, depend not only on the physical treatment conditions but also on the peculiar biological factors of the irradiated region. Therefore they cannot be exactly predicted in an individual case. Their various forms are classified in relation to their morphological aspect, degree and time of appearance, and briefly described. (auth)

51765 DETECTOR FOR THE INVESTIGATION OF THE KIDNEY FUNCTION. Silar, Josef Jad. Energ., 14: 257-66(July 1968). (In Czech).

Special detectors used for studying the functions of kidneys are described. Characteristics of detectors with three different type collimators are given in tabulated and graphical forms. (tr-auth)

51766 RADIATION INJURIES TO THE LOWER GASTROINTESTINAL TRACT. Nance, Francis C.; Persson, Alfred V.; Piker, John F. (Louisiana State Univ., New Orleans). Amer. Surg., 34: 21-5(Jan. 1968).

From 1948 to 1965, 3095 patients with carcinoma of the cervix and endometrium were treated by a combination of intracavitary Ra and external radiation with a total dose of 6600 R. In a review 24 patients were found with severe radiation injury to the bowel. Thirty-five operations were performed on these 24 patients, and 13 were left with a permanent colostomy. Five of the 24 died as a direct result of radiation injury without evidence of recurrence of tumor. Management of radiation injury was discussed. Proctitis occurred early and was a self-limited disease that responded well to conservative therapy. Rectal strictures were treated by intermittent dilatation. Progressive obstruction required colostomy in some patients. Resection of the stenotic area was possible in selected patients. Fistulae responded well to fecal diversion, which should be the first line of therapy. Selected patients were treated with subsequent resection. Associated vesicovaginal fistula may require exenteration for adequate control. The mortality of severe radiation injury was almost 20%. (BBB)

51767 LIVER PHOTOSCANNING WITH ^{99m}Tc SULFUR COLLOID. Freeman, Leonard M. (Albert Einstein Coll. of Medicine, Bronx, N. Y.); Rosen, Richard A. N. Y. State J. Med., 67: 3118-21(Dec. 1, 1967).

Methods of preparation of ^{99m}Tc sulfur colloid are described as well as its use in liver scanning. An intravenously administered dose of 10 μCi/Kg of body weight (minimum adult dose of 500 μCi) was found to be sufficient for clinical use. This supplied an average count rate of 25,000 to 30,000 cpm when a scanner with a 3- by 2-in. NaI crystal and a 19-hole focusing collimator were used. The radiation dose to the liver of a 70-Kg adult (using this dose) was only 170 to 230 mrad while the whole-body dose was ~12 mrad. A comparable ^{198}Au scan performed with 150 μCi delivers 3.9 to 6.4 rad to the liver and 350 mrad to the whole body. The ^{99m}Tc sulfur colloid liver scans were performed on 185 patients clinically suspected of having hepatic disease. It was found that if the spleen was well visualized with an administered dose of 10 μCi/Kg, a diagnosis of diminished hepatic perfusion could be made with a high degree of confidence. The ^{99m}Tc sulfur colloid photoscan may help clarify questionable findings on the ^{198}Au scan. The data-blended photoscan occasionally supplies information not found by the conventional nondiffused study. (BBB)

51768 COMPARATIVE RADIOPROTECTIVE EFFICIENCIES OF INJECTIONS OF FETAL LIVER OR ISOGENIC BONE MARROW IN IRRADIATED MICE. Duplan, Jean-Francois. (Laboratoire Pasteur, Paris). Compt. Rend., Ser. D, 267: 227-30(July 8, 1968). (In French).

The radioprotective effectiveness of fetal liver was found to be 1.7 times greater than that of bone marrow when equal numbers of cells were injected into whole-body 850 R x-irradiated mice. Survival time was used as the test criteria. This increased radioprotective effect of fetal liver was attributed to the rapid de-

velopment of hematopoietic cell precursors. This was demonstrated by measurements of the rate of mitosis in cells from bone marrow and fetal liver. (C.H.)

51769 SPECIAL ASPECTS OF THE PROTECTIVE EFFECT OF β-MERCAPTOETHYLAMINE DURING THE FORMATION OF CHROMOSOME ABERRATIONS IN LIVER CELLS OF MAMMALS IRRADIATED WITH γ RAYS. Nuzhdin, N. I.; Kurnishkov, I. S. (Inst. of Genetics, Moscow). Zh. Obshch. Biol., 26: 3-13(Jan.-Feb. 1965). (In Russian).

Mature male mice were irradiated with γ rays from a ^{60}Co source at the dose of 300 R (dose rate 269 to 207 R/min) with or without β-mercaptoethylamine (MEA) pretreatment. At various intervals after irradiation (3 to 180 days) when liver cells were stimulated with CCl_4 to divide, the animals were sacrificed. The frequency of cells with chromosome aberrations (dicentric bridges and acentric fragments) was studied. In the liver of mice irradiated without MEA protection the percentage of cells with chromosome aberrations remained constant for six months. In mice irradiated with MEA, a distinct protective effect could be revealed during the 10 days after irradiation. After this period the MEA protective effect did not manifest itself and the percentage of liver cells with aberrations was equal for protected and unprotected animals. It was concluded that the MEA administration before irradiation delayed the transition of latent damage of chromosomes to true breakage. (BBB)

51770 EFFECT OF X-RAY THERAPY ON THE UROPEPSIN EXCRETION. Zeitts, R. I.; Biryukov, G. E.; Mints, M. M. (PEdiatric Medical Inst., Leningrad). Pediatriya (Moscow), 43: 59-60(Oct. 1964). (In Russian).

During x-ray treatments of 48 children (aged two months to 14 yr) with single doses 100 to 200 R, the excretion of uropepsin increased in amounts determined by the region of the patients' body irradiated. Of the 48 children, 14 had lymphogranulomatosis, one myeloid leukemia, two hemophilia, two myositis, one xanthomatosis, and 28 neoplasms of various types and localization. The increased excretion of uropepsin was noted in most children following the first radiation exposure. After completion of the x-ray treatments, the symptoms reappeared in some patients in greater intensity than that at the initial stages. The average post-irradiation uropepsin level was 1½ times higher than the initial one. Of 13 children subjected to head irradiation, 11 showed a higher uropepsin excretion and two a normal level. The highest excretion was recorded after irradiation of the kidneys and abdominal cavity: of 14 children, 13 showed a high, and one a normal level. Of 18 children who completed radiation treatment of the neck and mediastinum, six showed elevated excretion, five a normal one, and seven no uropepsin reaction. Evidently, the elevated uropepsin excretion after irradiation of the head, kidneys, and abdominal cavity could be explained by the effects of x rays on the hypothalamus and adrenal glands. (BBB)

51771 TESTS OF RADIOSENSITIVITY AT THE MOLECULAR AND CELLULAR LEVEL WITH SOME COMPOUNDS DERIVED FROM PYRIMIDINES. Alvarez, V.; Astudillo, M. D.; Lopez Zumel, C.; Respaldiza, E.; Sanz, F. (Intitutos de Quimica Fisica y Farmacologia, Madrid). Arch. Inst. Farmacol. Exp. (Madrid), 17: 137-43(1965). (In Spanish).

Radiosensitizing activity of the following five pyrimidine derivatives was tested: uracil, thymine, orotic acid, 4-methyl-2-thiouracil, and 6-azauracil. The tests were conducted at the cellular level with the yeast, Saccharomyces cerevisiae, as well as at the molecular level with hemin. The optical density of hemin at 3900 Å was followed with increasing doses (42.5 to 170 Krad) of ^{137}Cs γ radiation, applied at 85 KR/hr, in the presence and absence of the 5 compounds at concentrations of 3×10^{-3}M in 0.01N NaOH solution. The concentration of hemin in this solution was 10 mg/l. In the tests with yeast, suspensions of 2×10^4 to 2×10^5 cells/ml were irradiated with ^{60}Co at doses of 20 to 120 KR. In neither system did uracil, thymine, or 4-methyl-2-thiouracil exhibit a radiosensitizing action. This confirmed previous results. Orotic acid appeared to have a protective effect on yeast cells but less effect on hemin, inhibiting only slightly the drop in absorbance at 3900 Å with increasing doses of radiation. With yeast cells, the presence of orotic acid increased the LD_{50} from about 20 to 40 Krad. (BBB)

51772 RADIOTHERAPY FOR CONDITIONS OTHER THAN CANCER. Sweet, R. D. Brit. J. Dermatol., 80: 265-6(Apr. 1968).

Injurious effects of irradiation for benign conditions were reviewed. An extensive survey of 1908 children who received scalp irradiation for ringworm exemplified the hazards. Among the survivors there were six cases of cancer in the irradiated group, four originating in the head or neck, and only one, Hodgkin's disease, in the control group. Mental disturbances were found three times as frequently in those irradiated and 23% were found to have obvious generalized hair loss. Another report mentions three girls who developed thyroid carcinomas in their early twenties and who had had repeated small doses of x rays for acne five to seven years before. Seven other cases of carcinoma of the thyroid were found in children under 16 yr old who had previously received incidental ionizing radiation to the neck, four of them in infancy. Five had treatment for vascular naevi, one for eczema, and one for a cheloid. In three of these the total dose was 300 rad or less. Another survey traced 334 cases of carcinoma of the thyroid throughout the world in children under the age of 15. In 20% there was a history of irradiation of the thymus. Evidently, the younger the patient the greater the risk. No cases of subsequent malignancy were found in 222 patients who had received purposeful thyroid irradiation when over the age of 20. Although the incidence and latent period were modified by increasing age, there was a possibility of cancer following irradiation of adolescents and that there is no certain minimal safe dose. The proneness of young people to disastrous after-effects totally contraindicates the use of low-voltage x rays for acne vulgaris, and grenz rays, that barely traverse the horny layer, can have little effect. If, as seems likely, ionizing radiation achieved results only by influencing cell division, grenz rays, though safer, influenced only those erythemato-squamous eruptions where cell division occurred in the squamous cell layer. Radiotherapy should be abandoned for all but malignant lesions in the skin. (BBB)

51773 RADIOTHERAPY IN THE LEUKEMIAS. Ridings, G. Ray (St. Paul Hospital, Dallas, Tex.). Radiol. Clin. N. Amer., 6: 83-9(Apr. 1968).

Radiobiologic principles in the treatment of leukemia are reviewed. It is now apparent that most leukemic lymphocytes are quite radiosensitive, although a certain percentage of cases are resistant even to doses as high as 1000 R. High-dose whole-body irradiation, its potentials, and its implications are thoroughly discussed. As to why large doses do not clear the leukemic process is explained. (TSS) (BBB)

51774 ^{131}I-LABELED TRIIODOTHYRONINE UPTAKE OF RED CELLS (HAMOLSKY'S TEST) IN PATIENTS WITH HYPERTHYROIDISM TREATED WITH RADIOACTIVE IODINE. Gasiorowski, Wiktor (Academy of Medicine, Warsaw). Endokrynol. Pol., 19: 15-20(1968). (In Polish).

The effect of radioiodine treatment of 62 patients (58 with hyperthyroidism) was studied on the basis of ^{131}I-labeled triiodothyronine uptake of the red cells. This test makes it possible to examine the thyroid function without the ingestion of radioactive material. This test is very useful in estimation of effects of treatment of thyrotoxicosis because the results of test are not influenced by previous use of radioiodine or antithyroid drugs. When this test was carried out in patients who had previously been treated with radioiodine and afterwards had been in the euthyroid state, it was noted that in most cases the uptake was decreased to the inferior limit of the norm or even in the hypothyroid range. Normalization of the results, which occurs after some time, may indicate achievement of the permanent euthyroid state with the restoration of the pituitary-thyroid feedback mechanism. On the other hand, persistence of the low results or a further decrease may indicate possible occurrence of hypothyroidism, whereas an increase of the uptake value to the limit characteristic for hyperthyroidism may be a sign of relapse. The results obtained were due to the influence of the radioiodine dose on thyroxine-binding protein. (BBB)

51775 A REPORT ON THE EFFECTS OF ANABOLIC STEROIDS ON THE ACUTE RADIATION SICKNESS OF RATS. Vodicka, Ivan; Dostal, Milan. Strahlentherapie, 135: 739-44(June 1968). (In German).

Rats were irradiated totally with 600 R x rays or ^{60}Co γ rays. One hour before the irradiation a dose of 3 mg 19-nortestosterone-caprinate was administered subcutaneously (Deca-Durabolin, Organon). The effect on weight, nitrogen balance, and polyuria was studied after the irradiation. The effect of the drug on control animals was also studied. Nandrolon reduced the polyuria in female irradiated rats during the first day after the irradiation. No effect on a negative nitrogen balance could be observed on the γ irradiated rats. The weight of irradiated animals and controls was not affected by the drug. (auth)

51776 ALTERATIONS IN THE KIDNEYS AND INTERNAL SECRETION GLANDS IN ANIMALS AFFECTED WITH ^{210}Po AND TREATED WITH HORMONES. Strel'tsova, V. N.; Poluboyarinova, Z. I. Med. Radiol., 13: No. 7, 40-6(July 1968). (In Russian).

Dogs subjected to ^{210}Po subcutaneous administration in a dose of 0.03 to 0.003 μCi developed functional changes in the kidneys of the mixed type of glomerular-tubular insufficiency with subse-

quent development of nephrosclerosis. Dogs treated with ^{210}Po proved to be more sensitive to the action of hormones (adrenaline, pituitrin, ACTH, desoxycorticosterone acetate) on the function and structure of the kidneys in comparison with nonirradiated animals. Animals with subacute effective levels of ^{210}Po under the effect of hormones of the hypophysis (ACTH and pituitrin) and to a lesser degree of the adrenal cortex (desoxycorticosterone acetate) increased somewhat the life expectation. Hormone treatment compensated the renal function (blood circulation, filtration, secretion, reabsorption) reduced the degree of injury of the renal parenchyma, and somewhat stimulated its regenerative possibilities. Adrenaline at early stages of the affection insignificantly increased the renal function and subsequently caused deterioration of the affection of the renal parenchyma. (auth)

51777 PROTECTIVE EFFECT OF CYSTAMINE ON THE CHROMOSOMAL ABERRATIONS OF LEUKOCYTES OF THE PERIPHERAL BLOOD DURING ITS IN VITRO IRRADIATION. Berlin, L. B. (Kirov Academy of Military Medicine, USSR). Dokl. Akad. Nauk SSSR, 180: 985-8(June 1, 1968). (In Russian).

Leukocytes of the pripheral blood were very sensitive to radiation; after exposure to 100 R, the number of aberrations increased about 20 fold with respect to the spontaneous level. Addition of cystamine resulted in decrease of chromosomal aberrations. Analysis of such aberrations in cystamine-protected and irradiated, and only irradiated cultures showed that the distribution of injured cells was not accidental and it was not subject to Poisson's law. The data agreed with chromosomal aberration studies of leukocytes exposed to 100 R of γ radiation. The recently reported protective effect of thiourea was difficult to compare with the above results because of the inadequate measurement of the radiation dose and experimental errors. (TTT)

51778 ^{99m}Tc-PERTECHNETATE SCINTIGRAPHY IN THE DIAGNOSIS OF DISEASES OF THE CRANIAL SALIVARY GLANDS. Gruenberg, H.; Boerner, W. (Univ., Wuerzburg, Ger.). Arch. Klin. Exp. Ohren- Nasen- Kehlkopfheilk., 187: 714-18(1966). (In German).

The radiation burden imposed by the ^{131}I thyroid test was compared with the radiation burden from the scintigraphic study of the salivary glands with $^{99m}TcO_4^-$. In the thyroid test 25 μCi of ^{131}I is given orally, and the radiation dose to the thyroid gland is 40,000 mrad with 25 mrad of whole-body irradiation. After administration of 1 mCi of ^{99m}Tc intravenously for salivary gland scintigraphy, the thyroid gland receives 250 mrad, the salivary glands 40 mrad, and the whole-body irradiation burden is 12 mrad. Detectability may vary considerably between paired glands. Changes in salivary gland function can be measured by scintigraphy before and after irradiation. An example is presented where γ radiotherapy of epipharyngeal tumor was evaluated by scintigraphic study of the area using ^{99m}Tc. (TSS)

51779 THE SACRED COW: A BRIEF LOOK AT THE RADIOISOTOPE GENERATOR. Meckstroth, George R. (Tulane Univ., New Orleans). Bull. Tulane Univ. Med. Fac., 27: 111-16(May 1968).

The preparation of short-lived radioisotopes such as short lived ^{99m}Tc, ^{113m}In, and ^{87m}Sr from radionuclide generators, and the uses of compounds of these radioisotopes in nuclear scintigraphic diagnostic procedures are described and discussed. (One criterion that must be considered when calculating the dose received by the patient is the half life of the radioisotopes. The shorter the half life, the less is the dose to the patient.) A short half life and the absence of β radiation make feasible the administration of mCi amounts, yielding high counting rates and improved resolution for scanning. As the pertechnetate ion (TcO_4^-), which is the most stable form in aqueous solutions, ^{99m}Tc metabollically resembles I. An advantage of ^{99m}Tc over ^{131}I is that the thyroid gland receives ~1/1000 of the radiation dose. The higher photon energy of ^{113m}In compared to ^{99m}Tc is more easily resolved by γ-ray spectrometry, which makes easier the precise delineation of the size and shape of certain lesions. However, for good resolution the higher energy of ^{113m}In requires collimators with thicker septa and thicker detector crystals than those used with ^{99m}Tc. In bone scanning ^{87m}Sr has the advantage of being a pure photon emitter and is superior to ^{85}Sr due to its shorter half life and its more readily collimated photons. Radionuclide generators that have been used and several additional generators that seem to be promising because of the physiological importance of the element, the desirable physical half life of the parent and daughter, or the energy and abundance of the photons emitted are listed. These include generators for ^{28}Si, ^{38}Ar, ^{42}Ca, ^{68}Zn, ^{72}Ge, ^{82}Kr, ^{83}Kr, ^{87}Sr, ^{90}Sr, ^{111}Cd, ^{113}In, ^{115}In, ^{125}Te, ^{131}Xe, ^{132}Xe, ^{137}Ba, ^{188}Os, ^{194}Pt, and ^{218}Po. (BBB)

51780 BIOLOGIC EXCISION: ITS VALUE IN THE TREATMENT OF RADIONECROTIC LESIONS. Marino, Hector (Buenos Aires Naval Hospital, Argentina). Plast. Reconstr. Surg., 40: 180-7(Aug. 1967).

Surgical experience with the use of skin flaps as a definitive therapy to be combined with the partial excision of radionecrotic lesions is recounted. The principle underlying this procedure is termed biologic excision. The technique and indications involved and the basic concepts that must be followed to assure its success are discussed and several cases illustrated. The only way to obtain a permanent cure of such lesions is by the complete surgical excision of the altered or dead tissues, the resulting defect then being covered with a well-nourished skin flap, preferably with a permanent blood supply. The immediate effects of biologic excision is the prompt relief of pain, which is the most common and serious symptom in radionecrotic lesions. In addition, sloughing ceases and dangerous complications, such as the rupture of great vessels, are averted. (TSS)

51781 COMPARISON OF ENDOLYMPHATIC ^{32}P LABELED AND ^{131}I LABELED LIPIDS IN THE VX_2 INVOLVED LYMPH NODES OF THE RABBIT. Lord, Reginald S. A.; Kinmonth, J. B. (St. Thomas's Hospital medical School, London). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 856-62(Aug. 1968).

The therapeutic effectiveness of endolymphatic ^{32}P and ^{131}I were compared in rabbits containing VX_2 lymphatic metastases. The ^{32}P treated group survived significantly longer than the ^{131}I group. The effects of ^{32}P and ^{131}I on the iliac lymph nodes were compared. Either isotope gave results vastly superior to no irradiation, and ^{32}P was marginally better than ^{131}I but the difference was not statistically significant. The greater β particle range of ^{32}P compared to ^{131}I seems to be advantageous. (auth)

51782 DELINEATION OF ABSCESSES BY SCINTIPHOTOGRAPHY USING ^{51}Cr LABELED LEUKOCYTES. Winkelman, James; Collica, Carl J.; Sandler, Sumner Gerald (New York Univ. Fordham Hospital, Bronx, N. Y.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 881-5(Aug. 1968).

A method is described for the delineation of septic abscesses in rabbits by scintiphotography using ^{51}Cr-labeled white blood cell preparations and a γ camera. The technique provides good images of abscesses in the extremities despite suboptimally pure labeled white blood cell preparations. Improved techniques of preparation, labeling, and scanning may allow extension of this approach for human patients in whom the presence and location of abscesses may be a diagnostic problem. (auth)

51783 RESULTS OF PROPHYLACTIC POSTOPERATIVE IRRADIATION IN 1,300 CASES OF PTERYGIUM. van den Brenk, H. A. S. (Royal Victorian Eye and Ear Hospital, Melbourne. Cancer Inst., Melbourne). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 723-33(Aug. 1968).

Results are recorded for 1,300 pterygia in 1,064 patients treated by simple excision of the lesion followed by prophylactic fractionated postoperative β-irradiation with a ^{90}Sr source used as a contact applicator. The irradiation was commenced within 12 hours of excision. The over-all recurrence rate was 1.7% (22 lesions); 1.3% for 1,185 primary lesions, and 1.6% for 115 pterygia recurrent after previous excision(s). No radiation cataracts were produced, but in four patients (0.3%) the sclera or cornea was damaged by irradiation. Postoperative irradiation dosage of 3 × 800 RADS, spaced at weekly intervals, gave the best cosmetic results, and a low recurrence rate of only 1.4% in 349 cases of pterygia. (auth)

51784 CLINICAL COMPARISON OF SCANS AND SCINTIPHOTOS OF THE THYROID GLAND. Robinson, Theodore; Collica, Carl J.; Chang, Soon (Fordham Hospital, Bronx, N. Y.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 738-45 (Aug. 1968).

Thyroid scans and scintiphotos of the thyroid were compared for a group of 100 patients with hyperthyroidism, hypothyroidism, goiter, or normal thyroid function. Approximately 50 μc ^{131}I was administered to the patients and 24 hr later rectilinear scans were made using a scintillation scanner and 61 hexagonal hole collimator and scintiphotos were made using a triple lens Polaroid γ camera with triple pinhole collimator. The uptake of ^{131}I by the patients ranged from 2% to 78% of the dose administered. The γ camera was found to produce superior images in a fraction of the time required for rectilinear scanning. (C.H.)

51785 ^{85}Sr BONE SCAN IN MYELOMA. Tong, Eddy C. K.; Rubenfeld, Sidney (New York Univ. Bellevue Hospital, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 843-8(Aug. 1968).

Five cases of histologically confirmed myeloma were scanned with ^{85}Sr. There was increased deposition of the radioisotope at the site of tumor corresponding to the area of osteolysis as noted in the roentgenograms. (auth)

51786 QUALITATIVE ALTERATION IN RADIATION INJURY UNDER HYPOXIC CONDITIONS. Phillips, Theodore L. (Univ. of California, San Francisco). Radiology, 91: 529-36 (Sept. 1968).

Mouse bone marrow and spleen colony-forming cells (CFU's) were used to test for a qualitative change in the type of injury occurring to cells irradiated under hypoxic conditions. With ^{60}Co γ radiations, dose-response curves obtained in vivo with endogenous spleen CFU's indicate an oxygen enhancement ratio of 2.6. A fall in the extrapolation number suggests that there would be decreased recovery with hypoxic cells. Split-dose recovery measurements reveal an increase in the survival ratio to a maximum of 2.8 with cells irradiated in animals breathing air, but the increase occurs at only one point and only to a level of 1.25 in animals irradiated while breathing 5% oxygen. To determine the exact nature of such dose-response curves, the effects of hypoxic irradiation on transplanted bone marrow CFU's were measured. Dose-response curves obtained in vivo with 300 kVp x rays showed an oxygen enhancement ratio of 2.3. The extrapolation number fell from 2 to 1.4 with hypoxia, and split-dose experiments with similar transplanted bone marrow CFU's indicate little or no early repair in hypoxic CFU's. Dose-response curves determined twenty-seven hours after the initial conditioning dose of radiation revealed that protection of cells by hypoxia continues during this time. Dose-response curves indicate that the degree of hypoxia obtained in vivo is similar to that in vitro and that the changes in the extrapolation number can be duplicated in vitro. This group of experiments indicates that severe hypoxia can be obtained in vivo and that radiation injury incurred under this condition is less reparable. These results suggest that one of the factors contributing to the success of fractionated radiotherapy may be the advantage obtained with multiple fractions in the killing of hypoxic cells as compared to the killing of normal oxygenated cells. Such alterations in recovery caused by qualitative differences in the type of radiation injury would be augmented by metabolic suppression of recovery by hypoxia present between exposures. (auth)

51787 MEASUREMENT AND CORRECTION OF NONUNIFORM SURFACE DOSE RATES FROM BETA EYE APPLICATORS. Hendee, William R. (Univ. of Colorado, Denver). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 734-7(Aug. 1968).

A differential filter was constructed from aluminum foil to reduce the dose rate nonuniformity across the surface of a commercial $^{90}Sr-^{90}Y$ applicator. The surface dose rate varied from 10.0 to 15.4 Rads/sec with the filter in place, and from 12.6 to 30.2 Rads/sec with the filter absent. The filter did not change the percent depth dose distribution from the applicator in tissue. More uniform doses to treated lesions were achieved with the filter, and improved clinical results are expected. A second filter was designed to shield regions peripheral to treated lesions less than 4.0 mm in diameter. Dose rates across the applicator surface, with and without filters in place, were measured with LiF thermoluminescent powder. (auth)

51788 EVALUATION OF THE PERIPHERAL CIRCULATION IN DIABETICS BY MEANS OF A MODIFIED RADIOISOTOPIC TECHNIC. Razzak, Muhammad Abdel; Hassaballa, Abdel Monem; Abou-Khatwa, Hassan (Cairo Univ.). Radiology, 91: 568-71(Sept. 1968).

In a group of 48 diabetic patients examined by means of a modified radioisotopic technic using iodine-131-labeled human serum albumin as the tracer, peripheral circulatory dysfunction was found to be unrelated to the duration of the disease and to the sex of the patient. In elderly patients and in those with peripheral neuropathy, however, the incidence of peripheral vascular affection was significantly higher. The technic is easy to perform and gives direct quantitative information about the peripheral blood vessels, including their ability to dilate. (auth)

51789 MORPHOLOGICAL CHANGES OF CANCER OF THE CARDIA IN BETATRON IRRADIATION 25 MeV. Savchenko, E. D.; Garvei, N. N.; Kornev, I. I. (Moscow Scientific-Research Roentgenologic-Radiological Inst.). Med. Radiol., 13: No. 9, 3-9(Sept. 1968). (In Russian).

Radiation therapy (bremsstrahlung–betatron with an energy of 25 MeV) was instituted in 38 patients suffering from cancer of the stomach with infiltration into the esophagus (third and fourth stages). The treatment was effected from two fields measuring 12 × 14 cm, with the source-skin distance averaging 70 cm. The total focal dose ranged from 2900 to 5500 RAD. In the majority of patients there occurred an improvement of the general state and reduction of the size of the tumor, whereas in 21 patients it became possible to finish the treatment by a radical surgical intervention 3 to 4 weeks after irradiation. Histological investigation of operative preparations showed two stages of destruction of neoplastic tissue: the presence of remnants of the tumor in the form of separate islets, and destruction of part of the tumor in the presence of areas of its active growth. Histological data revealed a varying degree of sensitivity of the parenchyma and stroma of gastric cancer, depending on its histological characteristics and value of the radiation dose. (auth)

51790 GAMMA THERAPY OF ESOPHAGEAL CANCER WITH ^{137}Cs RADIATION. Guseva, I. L. (Inst. of Experimental and Clinical Oncology, Erevan). Med. Radiol., 13: No. 9, 9-13(Sept. 1968). (In Russian).

After dosimetric investigations, rotation ^{137}Cs γ therapy of 125 patients suffering from cancer of the esophagus was performed. The immediate results of treatment are as follows: clinical recovery, 40%; palliative success, 56.8%; ineffective, 3.2%. The single focal absorbed dose was 150 to 175 RAD, the total focal absorbed dose was 6000 to 7000 RAD. The patients lived an average of 14.8 months. Radiation reactions were not stable, were of a reverse character, and did not serve as a contraindication to therapy. The results of treatment and the tolerance to irradiation proved to be better than in x ray therapy and approached those in ^{60}Co radiation. (auth)

51791 USE OF SCINTILLATION CAMERA AND ^{135}Xe FOR STUDY OF TOPOGRAPHIC PULMONARY FUNCTION. Newhouse, M. T.; Wright, F. J.; Ingham, G. K.; Archer, N. P.; Hughes, L. B.; Hopkins, O. L. (St. Joseph's Hospital, Hamilton, Can.). Resp. Physiol., 4: 141-53(Mar. 1968).

A technique is described that allows a quantitative, topographic evaluation of ^{135}Xe ventilation and perfusion distribution in the human lung using the Anger scintillation camera. Following an intravenous injection of about 0.5 mCi of ^{135}Xe, that evolved in the lungs and remained there during a breath holding period of about 30 sec, the distribution of radioactivity in the lung was determined. (TSS) (BBB)

51792 METABOLISM OF ^{68}Ga–EDTA IN RATS. Prpic, B. (Krebsforschungszentrum, Heidelberg). Acta Isotop., 7: 41-7 (Dec. 15, 1967). (In German).

Gallium-68-labeled EDTA is a substance with renal tropism. Its biological half-life is 35 min (effective half-life: 23 min), and its elimination through the kidneys is almost 100%. No secondary fixation processes are found. This complex could be useful in functional diagnostics of the kidneys. As demonstrated by the renograms, the curve of the ^{68}Ga-EDTA activity is similar to that of ^{131}I-Hippuran. The pharmacologic behavior of the complex is due to the organic part of the molecule. (auth)

51793 LIVER SCANNING WITH SPECIAL REFERENCE TO JAUNDICED PATIENTS. Eyler, William R.; DuSault, Lucille A.; Poznanski, Andrew K.; Schuman, Bernard M. (Henry Ford Hospital, Detroit). Lahey Clin. Found. Bull., 17: 13-20(Jan.-Mar. 1968).

The use of ^{131}I rose bengal, that is removed from the blood by the hepatic parenchymal cells, to demonstrate the liver, the biliary tree, and the functional relations between the biliary tree and the gut is described. Lugol's solution is given the preceding night to block the thyroid, and a dose of 2 μCi/kg of ^{131}I-rose bengal is usually given intravenously. The advantage of scanning with ^{131}I-rose bengal is the demonstration of biliary physiology. The visualization of the biliary tree and intestinal tract is not possible with other agents. The spleen, kidneys, and peritoneal cavity may also be shown. Using the techniques outlined, the radiation dose to the liver normally is about 150 mRad. The whole-body dose is less than 1 mRad. If the patient is constipated, the dose to the colon may be somewhat higher, in the range of 4 Rad. If there is complete obstruction of the biliary tree, the radiation dose to the liver may be increased to 5 Rad with a whole-body dose of less than 2 Rad. (BBB)

51794 ^{133}Xe-RADIOSPIROMETRY. A CLINICAL METHOD FOR STUDYING REGIONAL LUNG FUNCTION. Mioerner, Gunnar (Malmo General Hospital, Sweden). Scand. J. Resp. Dis., Suppl. No. 64, 1-84(1968).

The radiochemical characteristics of ^{133}Xe and its uses in studies of regional lung function are extensively described and discussed. The half-life of ^{133}Xe is 5.27 days. The β particles are absorbed by less than one mm of tissue. The radiation energy of ^{133}Xe has two maxima, one about 30 keV and one about 80 keV. If both energies are used for external measurements, smaller amounts of ^{133}Xe can be used with the same statistical precision, but the amount of scattered radiation increases and the resolution may decrease. The inert gas ^{133}Xe has low solubility in the body fluids. The Bunsen coefficient for water is 0.084 and for human whole blood 0.149 ± 0.006. The partition coefficient fat/blood is about eight, for brain/blood it is about one, and for other body tissues it is much lower. The use of ^{133}Xe in studies of regional perfusion is based on its low solubility in blood and rapid transfer from blood to alveolar air in the lung capillaries. Very low or high intrathoracic pressure may influence the distribution of perfusion. The tissue radiation doses with inhalation of a gas containing ^{133}Xe in a concentration of one mCi/l during one min, or injection of five mCi ^{133}Xe intravenously are for tracheal mucosa

96.8 mR, lung 17.5 mR, and gonads 1.1 mR. A routine examination including injection of 0.5 mCi ^{133}Xe, and, at most, 5 min rebreathing from the spirometer with about 0.2 mCi/l, would give doses to the tracheal mucosa of about 110 mR, to the lung of about 20 mR, and about 1.2 mR to the gonads. (BBB)

51795 EARLY CHANGES OF THE NERVOUS SYSTEM IN RADIUM THERAPY IN PATIENTS WITH MALIGNANT DISEASES. Oliper, T. V.; Filippova, G. P.; Khmelevskaya, Z. I. (Azerbaydzhan Inst. of Roentgenology, Radiology, and Oncology, Baku). Med. Radiol., 13: No. 9, 26-32(Sept. 1968). (In Russian).

The state of the nervous system was studied before and after radium therapy in 70 patients with malignant tumors of diverse locations and diseases of the hematopoietic organs. In most patients after radium therapy there were functional changes in the nervous system (anisocoria, nystagnus, augmented total level of tendon reflexes with anisoreflexia, disturbance of pain sensitivity in the irradiation zone), and disorders of the general regional hemodynamics. These shifts depended on the region of irradiation and the total dose. The most marked changes in the nervous system were noted when the spinal cord and neurovascular plexus were within the irradiation zone. In irradiation of the extremity (focal dose up to 7000 RAD) the shifts were usually of local character such as alteration of the sensitivity in the irradiation zone, disturbance of peripheral circulation in the affected limb. In children, along with local changes, there occurred also marked angiodystonic reactions, even in lower total doses of irradiation. (auth)

51796 FUNCTION OF THE THYROID AND SALIVARY GLANDS 10 TO 20 YEARS AFTER RADIATION TREATMENT OF CANCER OF THE LARYNX. Astrakhan, B. V.; Yudin, L. A. (First Moscow Inst. of Medicine). Med. Radiol., 13: 47-53 (Sept. 1968). (In Russian).

The function of the thyroid and salivary glands was investigated in 31 patients cured by means of γ radiation from laryngeal cancer 10 to 20 years before. The percentage of ^{131}I accumulation in the thyroid gland and the saliva-iodine test were used. Radiometric investigation of the saliva from the parotid gland was used to measure the secretory capacity and thyroid scanning was carried out. It was established that the function of the thyroid gland and saliva-iodine test change but little. Upon scanning of the thyroid gland there were found traces of morphological alterations. The concentration and excretory function of the parotid salivary glands were disturbed. (auth)

51797 ROLE OF THE ADRENAL CORTEX IN THE MECHANISM OF THE RADIOPROTECTIVE ACTION OF TESTOSTERONE. Moroz, B. B.; Efimov, I. N. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 458-60(1968). (In Russian).

The change in the corticosterone content in the blood plasma and in the tissues of the adrenals was investigated in intact and irradiated rats under conditions of protection with testosterone propionate. A single administration of testosterone three or ten days before irradiation prevents an increase in the corticosterone level in the height of radiation sickness, exerts a radioprotective effect, and makes the course of the disease lighter. The mechanism of the protective action of testosterone is associated with a change in the function of the adrenal cortex during radiation sickness. (JPRS)

51798 SOME ASPECTS OF THE PROTECTION OF NUCLEOPROTEINS FROM THE INFLUENCE OF IONIZING RADIATION. Pisarevskii, A. N.; Spitkovskii, D. M.; Andrianov, V. T.; Martynov, E. V. (Inst. of Experimental Biology, Moscow. Belorussian State Univ., Minsk). Radiobiologiya, 8: 339-46(1968). (In Russian).

The comparative radiosensitivity of deoxyribonucleoprotein (DNP) was studied in the gel and condensed states. It was shown that the radio-resistance of formed nucleoprotein strands is increased by one to two orders of magnitude. The introduction of a number of protective substances into a DNP gel leads to an increase in the critical dose leading to loss of the structure-forming properties. The best protective ability is possessed by AET and MPA and gallates. Irradiation of DNP gels by doses below the critical does not lead to any change in the number of structuromechanical properties if protective substances are introduced into the DNP gels before irradiation. The greatest activity is possessed by FINAM. In the irradiation of condensed DNP structures, the change in the relaxation properties is entirely suppressed when AET and MPA are introduced into solution. Stepwise deproteinization of DNP leads to an increase in the radio-resistance of the nucleoprotein. It is hypothesized that the lysine-enriched fraction of histone is responsible for the change in the structuromechanical properties of the nucleoprotein complex. (JPRS)

51799 LOCALIZATION OF THE PLACENTA BY RADIOISOTOPES. Chosson, J.; Roux, H.; Sudan, J. P.; Paulin, R.; Charrier, J. P. (Obstetrics and Gynecology Clinic, Marseille). Bull. Fed. Soc. Gynecol. Obstet. Langue Fr., 19: 124-7(Apr.-May 1967). (In French).

Techniques and safety features of two isotopes, ^{132}I and ^{99m}Tc, in the localization of the placenta were considered. Observations of 35 cases in which ^{132}I placentography was used showed an excellent tolerance for this isotopic procedure. The only precaution necessary was to saturate both maternal and fetal thyroids with iodide before the test. This was done by giving the women 20 drops of Lugol's solution three times a day for two days before radioiodine tests were made. The advantages of using the new method for ^{99m}Tc were discussed. Technetium-99m had a short half-life period which eliminated hazards to the fetus. It was attached to serum albumin, and emitted pure γ radiation thus permitting scintigraphy. There appeared to be no dangers associated with its use. The effects of radioisotope-labeled serum albumin on 31 mothers were studied. Only seven times very slight reactions occurred, from 20 to 25 min after injection. The effect was always brief (10 to 15 min), and no body temperature elevation occurred. After 24 hr the women showed no after-effects. These can be prevented by an antihistamine injection and by 200 mg of potassium perchlorate one or two hr before the examination. Calculations showed irradiation of the fetus to be infinitesimal and practically speaking negligible. Placental scintigraphy gives the fetus about 14 mRad as compared with 1 Rad received when two abdominal x rays are taken. It was concluded that ^{99m}Tc scintigraphy was safer and more efficient than that with ^{132}I. (BBB)

51800 CHEMICAL RADIOPROTECTION OF m RNA IN A NIRENBERG CELL FREE SYSTEM. Robev, S.; Jankova, D. (Inst. Radiology and Radiation Hygiene, Sofia). Nature (London), 216: 1319-20(Dec. 30, 1967).

Some studies are reported on the radioprotective effect of 0.015% concentration of cysteamine hydrochloride on poly-U. Lower concentrations were found to be less effective. The strong dependence of radioprotective activity on concentration of the amine hydrochloride in the range 0.015 to 0.0015% appears to support deoxygenation of the irradiated poly-U solutions caused by cysteamine. This, however, is not in accord with the observation of other workers that a decrease of oxygen content in poly-U solutions during irradiation lowers the radioresistance of poly-U, as checked by ^{14}C-polyphenylalanine synthesis in a cell free system, which suggests that specific "cysteamine" radioprotection cannot be excluded. (INIS) (UK)

51801 RADIOCHEMOPROPHYLAXIS IN ACUTE WHOLE-BODY RADIATION. Overman, Richard R.; Jackson, Sara Jean (Univ. of Tennessee, Memphis). Annu. Rev. Med., 18: 71-80 (1967).

A delineation of the present status of radiochemoprophylaxis against acute whole-body radiation in mammals is presented to indicate some of the reasons for the status in quo and to suggest directions for future efforts aimed at both improving the practicality of radiochemoprophylaxis and widening the horizon of usefulness for this potentially important addition to the medical armamentarium. The survey of the literature pertaining to the review was concluded in August, 1966. (B.S.L.)

51802 SEQUENTIAL RADIOFLUORIDE PHOTOSCAN STUDIES OF AUTOGENOUS BONE GRAFTS. Sako, Kumao; Marchetta, Frank C.; Matsuura, Hidehiro (Roswell Park Memorial Inst., Buffalo). Amer. J. Surg., 115: 626-9(May 1968).

The use of ^{18}F for repeated scans to follow the progress of incorporation of bone grafts is reported. The difficulty with the use of ^{47}Ca for scan studies of fractures and the detection of early localized bone lesions is in shielding and collimating the high energy of the principal γ ray. The problem with ^{85}Sr is that it has a long physical half-life (65 days) and the resulting irradiation of the patient from even small doses is appreciable. A new isotope, ^{18}F, emits a 0.65 MeV positron and has a half-life of 1.87 hr. In experimental animals the concentration of ^{18}F in the areas of regenerating bone is more than 10 times higher than in normal bone. Concentration of ^{18}F was found at the site of the fracture from two weeks to three yr postfracture when there was normal healing, and a high uptake at the site of fractures with nonunion of two to three yr duration. Sequential radiofluoride photoscans used to follow experimental bone autografts in the tibia of dogs were more sensitive than roentgenograms and correlated with the histologic progress of the grafts in incorporation and remodeling. (BBB)

51803 CONTRAST AND THE KILOVOLTAGE FACTOR. Gould, D. R. (Swansea Hospital, Eng.). Radiography, 33: 179-82(Aug. 1967).

Theoretical and practical aspects of the influence of x-ray energy on tissue contrast in radiography are examined. A table shows the attenuation of theoretically homogeneous x-ray beams each of different wavelength by a sheet of Cu 0.25 mm thick. The Cu sheet

attenuated the 0.2 Å beam to a greater extent (29%) than the 0.1 Å beam (7%), and the 0.4 Å beam to a still greater extent (90%) than the 0.2 Å beam. The percentage values express the fact that radiation suffers disproportionate attenuation with increase in wavelength. It is owing to this fact that a change in kilovoltage affects the extent to which a given structure attenuates an x-ray beam. Attenuation of homogeneous radiation by a homogeneous substance is exponential; that is, the attenuation that takes place in successive layers of equal thickness is always the same percentage of the amount of radiation that is incident on each layer. The percentage varies with wavelength and also with the particular substance, but for a given wavelength and a given substance it is constant. Aluminum wedge experiments are described. The shorter the wavelength of the incident photon, the greater the tendency to scatter in a forward direction, that is in the direction of the film. This phenomenon may contribute to the greater scattered radiation component of the transmitted beam when the kilovoltage is increased. Generally, within the principle of kilovoltage-thickness exposure techniques, the use of the lowest possible values of kilovoltage is not advantageous. The milliampere-seconds factor required to produce a given degree of overall radiographic density increases with decrease in kilovoltage; therefore, the use of lower kilovoltages increases the integral dose to the patient. (BBB) (TSS)

51804 RECENT ADVANCES IN RADIATION THERAPY. Bogardus, Carl R. Jr. (Univ. of Oklahoma, Oklahoma City). J. Okla. State Med. Ass., 61: 11-15(Jan. 1968).

Factors, such as irradiation dose fractionation, supervoltage irradiation, relative radiosensitivity of tumor tissue as a function of O_2 saturation and effects of preoperative irradiation treatment are discussed. The maximum efficiency of cell-killing is accomplished by use of the least number of fractionated irradiation doses. The increased depth dose which results from the use of supervoltage radiation equipment greatly reduces the amount of radiations which must be delivered to intervening normal tissues between the skin surface and the tumor. Intensive high-dose preoperative irradiation can effectively destroy a large percentage of the viable cells within a given tumor population. Although this does not effect a cure of the tumor, it can decrease the tumor size and viability of the individual cells. The amount of ionizing radiations necessary to produce a given change in many biological systems is 2 to 3 times as great with a moderate degree of anoxia as in the presence of O_2. It is important that O_2 be present at the time of irradiation. The magnitude of O_2 effect varies with the amount of O_2 available. In most intact malignant tumors there are cells in the central portion of the tumor that are poorly oxygenated and in many cases quite anoxic. The relative radioresistance of these cells is probably due to their relative anoxia. This could account for failure to completely eradicate all of a relatively large tumor, whereas a small tumor of the same general cell type may be totally eradicated. (BBB) (TSS)

51805 IN VIVO DOSIMETRY IN THE LUNG FOR INTERNALLY ADMINISTERED RADIOACTIVE ISOTOPES. Darnell, Thomas Cragun. Los Angeles, Univ. of California, 1967. 54p. Thesis.

Solid lithium fluoride (LiF) rods were encapsulated, by means of electronic shrinkable tubing, to prevent etching by the body fluids. The resultant dosimeters, 2 mm × 7 mm, were immersed in known solutions of ^{131}I or ^{99m}Tc to affect a calibration curve by plotting the computed dose against the digital readout for each dosimeter. Fourteen mongrel dogs, weighing 18 to 25 kilograms, were anesthetized, injected intravenously with 300 μCi of ^{131}I or 2.2 mCi of ^{99m}Tc, and dosimeters introduced, via the jugular vein, into the lungs. Twenty hours later the animals were sacrificed and the dosimeters recovered and readout within two hours after removal from the lung. In comparing the measured doses to the lung from the in vivo studies with the computed theoretical doses, a difference of as much as 20-1 for ^{131}I and as much as 10-1 for ^{99m}Tc was observed. The difference existing between the two methods is attributed, in part to the variable rate of MAA removal from the lung and the short range (0.6 mm) of the beta component of the radionuclides in the tissue. The measured absorbed doses are considered to be a realistic indication of the average dose to the entire lung (~400 mrad for ^{131}I and 150 mrad for ^{99m}Tc) whereas, the computed theoretical average dose to the lung is considered to be representative of the dose to the epithelium (~5 rad for ^{131}I, and 1.5 rad for ^{99m}Tc), rather than to the overall lung. It was observed that ^{99m}Tc compared with ^{131}I contributes 1/10 the dose to the lung for the same given specific activity. These findings indicate, from a safety standpoint, that ^{99m}Tc is a better radionuclide for lung scanning than is ^{131}I. (Disser. Abstr.)

51806 VASCULAR CHARACTERIZATION OF BRAIN LESIONS BY RAPID SEQUENTIAL CRANIAL SCINTIPHOTOGRAPHY. Fish, Mathews B.; Pollycove, Myron; O'Reilly, Sean; Khentigan, Archie; Kock, Robert L. (San Francisco General Hospital, Univ. of California, San Francisco). J. Nucl. Med., 9: 249-59(June 1968).

A technique is described for the detection and vascular characterization of intracranial lesions. This technique consists of the administration of ^{99m}Tc-pertechnetate (10 mc) by antecubital intravenous bolus injection followed by immediate rapid sequential and delayed scintiphotography using an Anger-type scintillation camera. The results of multiple studies indicate that arterial capillary and venous phases can be visualized and distinguished. Analyses of these results provide mean time intervals for the various vascular phases on anterior and posterior viewing Representative studies from patients with a variety of intracranial lesions, primary neoplasm, cerebral infarct, and subdural hematoma, were shown to demonstrate vascular and avascular lesions and their relationship to blood-brain-barrier abnormalities. The advantages of this technique are discussed with emphasis on the great amount of relevant information obtained, the relative ease and speed of performance, patient safety, and the possibility of acquiring data on the vascular characterization of intracranial lesions not obtainable by conventional brain-scanning or current methods of cerebral angiography. (auth)

51807 RENAL EXCRETION OF RADIOIODINATED ROSE BENGAL: A PITFALL IN THE INTERPRETATION OF ROSE BENGAL ABDOMINAL SCANS. Freeman, Leonard M.; Kay, Chester J.; Derman, Arnold (Albert Einstein Coll. of Medicine, Bronx, N. Y.). J. Nucl. Med., 9: 227-32(June 1968).

Extrahepatic biliary-tract obstruction as well as severe intrahepatic disease causes increased renal excretion of radioiodinated rose bengal. Experimental evidence indicated that there was continual dissociation of ^{131}I from rose bengal in vivo and indirectly suggested that a good portion of this urinary excretion may be in the form of free ^{131}I. The importance of recognizing renal activity on rose bengal abdominal scans lies in the need to differentiate it from intestinal activity and to avoid an erroneous impression of a patent biliary tract where obstruction actually exists. (auth)

51808 SCANNING OF LIVER AND BRAIN IN EVALUATION OF PATIENTS WITH BRONCHOGENIC CARCINOMA. McCormack, K. R.; Greenlaw, R. H.; Hopkins, C. (Univ. of Kentucky, Lexington. Dept. of Public Health, Frankfurt, Ky.). J. Nucl. Med., 9: 222-4(June 1968).

Sixty-four brain scans and 59 liver scans were performed as part of the initial evaluation of patients with bronchogenic carcinoma. The scans were found particularly useful in differentiating metastatic spread from other causes of signs and symptoms in patients with clinical findings suggestive of metastatic spread to liver and brain. Positive-scan evidence consistent with metastatic spread in those patients without suggestive clinical findings was relatively unsuccessful, with positive scans found in only two of 31 asymptomatic liver-scan patients and in only one of 43 asymptomatic brain-scan patients. With the present technical limitations on the minimum size abnormality that can be readily demonstrated in these large organs, the chances of defining asymptomatic lesions are quite small. (auth)

51809 ASSESSING THE PERFORMANCE OF RADIOISOTOPE SCANNERS: DATA ACQUISITION. Cradduck, T. D. (Manitoba Cancer Treatment and Research Foundation, Winnipeg). J. Nucl. Med., 9: 210-18(June 1968).

A computer method of assessing the performance of both moving and stationary scintillation detectors used as radioisotope scanners is described. This method uses the line source response function to calculate the modulation transfer function of the system. The modulation transfer function is the method that is being used increasingly to describe the performance of optical and radiographic systems. In addition to the modulation transfer function, a method of defining the sensitivity to a sheet source of activity is described. This sensitivity is then combined with the modulation transfer function to give a figure of comparison. (auth)

51810 OCCUPATIONAL EXPOSURE TO X RAYS. Dixon, R. T. (Univ. of Sydney). Vet. Rec., 82: 780(June 29, 1968).

It is recommended that, wherever possible, owners should not hold their animals for radiographic examination. This will expose owners to radiation doses that may be higher than expected and it may remove any incentive to the veterinarian to utilize safe radiographic techniques and equipment. Data indicate that veterinarians employing safe x-ray units and adequate radiation safety precautions do not achieve a body exposure dose in excess of the maximum permissible dose. However, the exposure dose per radiograph to members of the public may be twice as high as the dose to the veterinarian or his trained lay staff, and may well be higher. Also, the maximum permissible dose for the general public is 10% of the level for radiation workers. Where the duties of restraint and positioning were shared equally between staff

and students, the dose per exposure to the radiologist was 0.04 mrem whereas the dose to the student was 0.09 mrem (both using protective clothing). Other figures indicated that the exposure dose per radiograph of small animals was 0.07 mrem for the radiologist and 0.15 mrem for the assistant; in radiography of horses these doses were increased to 0.1 mrem for the radiologist and up to 1.04 mrem for the assistant. (BBB)

51811 INFLUENCE OF RECTANGULAR COLLIMATION AND INTRAORAL SHIELDING ON RADIATION DOSE IN DENTAL RADIOGRAPHY. **Winkler, Keith G. (National Center for Radiological Health, Rockville, Md.). J. Amer. Dent. Ass., 77: 95-101 (July 1968).**

A laboratory study was made to determine the reduction in radiation exposure obtained by use of a small rectangular x-ray beam restricted to the approximate size and shape of the intraoral film, when combined with a shield to absorb a major portion of the radiation behind the film. Thermoluminescent dosimetry and a phantom bust of a human were utilized to assess radiation exposure and absorbed dose. The surface exposure integrals for a 22 film series with and without the film-holding rectangular collimator were, respectively, 54 and 148 R X/cm^2. The calculated integral absorbed doses were, respectively, 338 and 961 grad. A graph shows the doses absorbed by specific tissues of the head and neck during the 2 film series on the phantom. Dose comparisons between the standard-sized round beam and the smaller rectangular beam illustrate the pronounced reduction in dose resulting from the difference in the amount of overlapping of exposed sites. The appreciable reduction in patient dose possible with this principle indicates the desirability of evaluating it further and possibly adopting it clinically. (BBB)

51812 IMPROVED TEST METHODS FOR SCANNER EVALUATION. Bramlet, Roland C. (Long Island Jewish Hospital, Jamaica, N. Y.). J. Nucl. Med., 9: 260-2(June 1968).

A method is described for the evaluation of the resolution of a 10-crystal, 10-channel rectilinear scanning spectrometer. Line sources were made by placing a radioactive solution in glass capillary tubes commonly used for micro-hematocrit determinations. Two of these sources were positioned under the scintillation detector at specified intervals. A second pattern of radiation sources was also made using 16 line sources mounted in a radial pattern on an aluminum plate with the capillary tubes secured by epoxy resin cement. Solutions of ^{99}Tc were used to load the glass tubes. Collimators with focal lengths of 3.5, 4, and 5 in. were used. The radiations from the ^{99}Tc sources were scanned by a spectrometer setting of 93 to 187 keV. Advantages of the test system for the evaluation of the resolving power of radiation detection instruments for purposes of radioisotope scanning are considered. (C.H.)

51813 HYPOTHYROIDISM AND ^{131}I THERAPY. **Ellis, Frank (Churchill Hospital, Oxford). Brit. Med. J., 2: 314 (Aug. 3, 1968).**

After treatment of thyrotoxicosis by radioiodine, myxedema tends to occur. Some cases of myxedema must be considered inevitable owing to a gradual failure of the gland starting before the administration of radioiodine even though it was preceded by the development of thyrotoxicosis. Evidence is cited that sometimes the function is partly physiological and partly pathological as indicated by the possibility of suppressing part of the function of the gland by the administration of triiodothyronine (T_3) before the radioiodine uptake test is carried out. The chief component of the radiation from ^{131}I is β radiation, and judging from the fact that the use of external radiation is less efficient, the effect of radioiodine in destroying the function of the gland is mostly by the β component. Thus, the effect of all the radiation will be sharply local and will not extend much, if at all, beyond the cells that have taken up the radioiodine. Assuming, therefore, that it is desirable to destroy pathologic tissue and to leave physiologic tissue intact, it would seem reasonable to give the radioiodine after a course of T_3 so as to suppress any physiologic thyroid tissue that is present. This procedure, for cases in which it is considered safe to use T_3 in the presence of thyrotoxicosis, offers the possibility of limiting hypothyroidism to those cases in which it may be unavoidable. Moreover, smaller repeated doses to treat the pathological cells should be a rational method of treatment. (BBB)

51814 THE DIAGNOSTIC AND PROGNOSTIC VALUE OF ^{85}Sr PHOTOSCANNING IN CARCINOMA OF THE PROSTATE. **Williams, Donald F.; Blahd, William H. (Univ. of California, Los Angeles). J. Urol., 97: 1070-4 (June 1967).**

Possibile use of ^{85}Sr to detect prostate cancer in its early stages was evaluated in 20 patients with prostatic adenocarcinoma in various clinical stages. Skeletal system photoscanning with ^{85}Sr was performed on patients given an injection of 125 μCi of ^{85}Sr intravenously. Photoscanning was performed 72 hr later. It was shown that such photoscans can detect metastatic disease prior to any demonstrable roentgenographic bone changes in patients with carcinoma of the prostate. The metastatic bone survey was considered positive in 9 patients all of whom had positive scans. X rays were negative in 9 patients; however, the scan detected metastatic disease in 5 of these patients. In 20% of this series (5 of 20) the scan was positive when the x-ray was negative. The photoscan detected more extensive disease in patients with known metastatic lesions than shown by routine roentgenograms. The ^{85}Sr scan was also far superior to serum determinations of acid or alkaline phosphatase and bone marrow biopsy. It is proposed as a preoperative adjunct in evaluation of patients with adenocarcinoma of the prostate potentially curable by radical, total prostatectomy. It is also a useful tool in following patients with known metastatic disease particularly when radiotherapy is contemplated. Since ^{85m}Sr has the same photoscanning capability as ^{85}Sr but produces a radiation dose of less than 1% that of ^{85}Sr, it may provide a tool for the more extensive study of malignant disease. Testosterone is being given to patients prior to scanning in an attempt to enhance the uptake of Sr by the metastatic bone lesion. Also being investigated are the whole-body radioactivity and effective half-life of ^{85}Sr by monitoring the patient in the whole-body counter. (BBB)

51815 LIVER HYPERTROPHY, LIVER GLYCOGEN ACCUMULATION, AND ORGAN-WEIGHT CHANGES IN RADIOTHYROIDECTOMIZED AND GOITROGEN-TREATED CHICKS. **Snedecor, James G. (Univ. of Massachusetts, Amherst). Gen. Comp. Endocrinol., 10: 277-91 (1968).**

Radiothyroidectomy was carried out by giving 5- or 10-day-old cockerels 1.7 mCi ^{131}I per 100 g body weight, and the effectiveness of the resulting radiothyroidectomy as well as of thiouracil, propylthiouracil, and methimazole in producing hypothyroid changes was studied. Changes in glycogen content and relative size of the liver were sensitive indicators of severe hypothyroidism. Changes in body, comb, testes, thyroid, and bursa weights are also considered. Doses of 0.1, 0.15, and 0.2% thiouracil (TU) were equally effective in producing hypothyroid changes up to age three weeks. An equimolar amount of propylthiouracil (PTU) was slightly more effective than 0.2% TU up to age 30 days. Radiothyroidectomy and 0.2% PTU were equally effective to age five weeks, but PTU had a greater depressive effect on body weight because of its probably disagreeable taste and consequent effect upon food intake. Methimazole at 0.1% was as effective at 0.2% or 0.3% TU to age five weeks, but 0.05% and 0.025% methimazole were relatively ineffective except in thyroid weight changes. Amounts of iodinated casein one-third to one-fourth the amount equivalent to normal thyroid hormone secretion when added to TU diets allowed normal growth in most organs measured, and normal liver glycogen, but the thyroid hypertrophied. Withdrawal of normalizing exogenous thyroxine from radiothyroidectomized chicks resulted in liver hypertrophy and increased glycogen accumulation within 48 hr. (BBB)

51816 AMPLITUDES OF VISUAL ACCOMMODATION OF ATOMIC BOMB SURVIVORS IN NAGASAKI AND HIROSHIMA CITY. **Hirose, Izumi (Yamaguchi Prefectural Central Hospital, Japan); Fujisawa, Hideo; Fujino, Tadashi; Okamoto, Akira. Nippon Ganka Kiyo, 18: 346-60 (Mar. 1967). (In Japanese).**

Visual accommodation of atomic bomb survivors in Nagasaki and Hiroshima City was examined as part of the Adult Health Study (ME-200) jointly conducted by the Atomic Bomb Casualty Commission and the Japanese National Institute of Health. Four groups of survivors or controls were examined: Group 1, within 2000 m from the hypocenter and with acute symptoms of irradiation exposure; Group 2, within 2000 m but without acute symptoms of irradiation; Group 3, 3000 to 3999 m in Nagasaki and 3000 to 3499 m in Hiroshima from the hypocenter; and Group 4, 10,000 m or more at the time of the explosion. The results include those found in 1628 eyes (844 cases) tested in Nagasaki from November 1959 to August 1960 and 1539 eyes (859 cases) tested in Hiroshima from September 1959 to February 1960. Measurements of the amplitudes of visual accommodation in 1604 individuals, including atomic bomb survivors and persons who were not in Nagasaki and Hiroshima at the time of the bombing, are tabulated. No appreciable differences in the amplitudes of visual accommodation were noted between atomic bomb survivors and controls. However, the group located within 2000 m of the hypocenter with acute symptoms of irradiation included subjects with lenticular lesions, such as polychromatic sheen, polychromatic granular sheen, and plaques at the posterior pole of the lenses. (BBB)

51817 ON THE VALIDITY OF IRON KINETICS WITH ^{59}Fe FOR THE DIFFERENTIAL DIAGNOSIS BETWEEN IDIOPATHIC AND HEPATOPATHIC HAEMOCHROMATOSIS. **Scandellari, C.; Dobrilla, G.; Bosello, O.; Cavallini, G.; Lo Cascio, V.; Cartei, G. (Univ., Padua). Acta Isotop., 7: 117-34 (Dec. 15, 1967). (In Italian).**

The significance of ^{59}Fe-kinetics was examined with respect to the differential diagnosis of hepatic diseases with iron overload. Studies with radioiron were carried out in eight idiopathic hemochromatosis patients; in four with secondary hepatopathic hemochromatosis; and in five with transfusional hemosiderosis. The radioactivity of the liver was usually abnormally elevated in idiopathic as well as transfusional hemochromatosis cases; however, it was in normal range in hepatopathic patients. Such a study appears useful in discriminating both types of hepatic hypersiderosis (primitive and secondary) and also in discovering the subclinical hemochromatosis. (auth)

51818 RADIOISOTOPE SCANNING OF SUPERIOR MEDIASTINAL MASSES. Wang, Yen (Presbyterian-Univ., Pittsburgh. Magee-Women's Hospital, Pittsburgh. Homestead Hospital, Pittsburgh). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 766-71(Aug. 1968).

Radioisotope scanning was used for studying the superior mediastinal mass shadows demonstrated on chest roentgenograms. Superior mediastinal and neck scanning was performed in one sitting, using ^{131}I cholegrafin, ^{131}I SA, or ^{99m}Tc colloids. This combined scanning technique was found to be very valuable in the differential diagnosis of substernal thyroid, aneurysm, and tumor mass. (auth) (TSS)

51819 HYDROCORTISONE PROTECTION OF KB CELLS SUBMITTED TO THE ACTION OF VARIOUS STRESS AGENTS. Chany, Edith; Aujard, Colette (CNRS, Villejuif, France). Arch. Sci. Physiol., 22: 111-26(1968). (In French).

Experiments were performed to determine the effect of uv radiation on KB cells and the protective effect of hydrocortisone against uv radiation. KB cells in culture were divided into two groups, those receiving hydrocortisone injection and those not receiving it. The first experiment extended over seven days, with one group of cells being irradiated with a uv germicidal lamp for varying lengths of time. It was found that the percentage of cells retaining their ability to attach to glass diminished after exposure to uv and that the percentage of attached cells treated with hydrocortisone was greater than for the control group. The second experiment consisted of exposing one group of cells to uv for 1/2 hr. In the irradiated control group only 24% of the cells became attached to glass but in the nonirradiated group 43% did. It was found that hydrocortisone had a definite protective effect against uv irradiation. (BBB)

51820 PITUITARY ABLATION FOR ADVANCED CARCINOMA BY TRANSNASAL IMPLANTATION WITH RADIOACTIVE YTTRIUM. O'Halloran, M. J.; Carey, P.; O'Connor, J. E.; McGrath, M.; Douglas, S. J. (St. Luke's Hospital, Dublin). J. Irish Med. Ass., 60: 321-5(Sept. 1967).

Two rods, each having an activity of 4.5 mCi, were implanted under fluoroscopic control. Complications observed in 33 patients included 22 of increased thirst, nine postoperative headaches, four visual disturbances, and two cerebrospinal fluid leaks. All responded to routine measures. The operation was abandoned in two of 37 patients. Pituitary ablation was used in advanced diabetic retinitis, malignant exophthalmos, chorion epithelioma of the testis, prostatic cancer, melanoma, carcinoma of cervix and vulva, multiple myelomatosis, and Cushings syndrome, but the results were very disappointing especially with the carcinomas. Its greatest application was in breast carcinoma. Increasing the dose of ^{90}Y would increase postoperative complications. (BBB)

51821 OPTIMUM DIMENSIONS OF PARALLEL-HOLE, MULTI-APERTURE COLLIMATORS FOR GAMMA-RAY CAMERAS. Keller, Eldon L. (Westinghouse Research Labs., Pittsburgh). J. Nucl. Med., 9: 233-5(June 1968).

Gamma cameras are used to image organs where a choice of radioisotopes is possible. The influence of the choice of collimators on the resolution and sensitivity of the camera is discussed, and optimum dimensions of parallel-hole multi-aperture collimators are presented. (C.H.)

51822 OUTLINE OF AN OPPOSED SCINTILLATION-SCANNER OF 5 IN. ϕ AND ITS EFFECTIVENESS. Okamoto, Shiujiro; Murayama, Hiroyasu (Tokyo Medical Coll.). Radioisotopes (Tokyo), 17: 287-93(July 1968). (In Japanese).

Radioisotopes administered to patients showed in the organs destined distributions varying with the patients' individual differences and different phases of involvement. The count also varied with the size, shape and position of the organ. It was difficult to grasp perfectly the radioisotope conditions of a three-dimensional organ from a scintigram that was only a one-dimensional representation. For improving the diagnostic quality of the scintigram through representing the behavior of radioisotopes in the organ as faithfully as possible, a scanner was developed in which two detectors using, respectively, a scintillator of 5 in. $\phi \times$ 2 in. that were opposed. This apparatus enabled scintigrams to be obtained utilizing the upper detection count, the lower detection count, the addition of these two counts, the upper count subtracted by the lower count, and the simultaneous counting of the upper and lower counts. These methods, the improvement of the measuring instrument, the enlargement of the scintillator and the opposed layout of the detectors, greatly improved the sensitivity and the resolution, thus enabling scintigrams of high diagnostic quality to be obtained. (auth)

51823 TRANSMISSION SCINTIPHOTOGRAPHY. Anger, Hal O.; McRae, James (Univ. of California, Berkeley). J. Nucl. Med., 9: 267-9(June 1968).

A method is described for making transmission pictures of the lungs, diaphragm, and heart of patients in anterior, posterior, and lateral projections using a scintillation γ camera and a radioactive source on the opposite side of the patients. Transmission pictures are of value for relating radioisotope scans to anatomy of the patients. (C.H.)

51824 SIMPLIFIED METHOD FOR SIMULTANEOUS DETERMINATIONS OF PLASMA VOLUME AND RED-CELL MASS WITH ^{125}I-LABELED ALBUMIN AND ^{51}Cr-TAGGED RED CELLS. Grable, Ernest; Williams, John A. (Beth Israel Hospital, Boston. Harvard Medical School, Boston). J. Nucl. Med., 9: 219-21(June 1968).

A simplified method is described for simultaneously determining red-cell mass and plasma volume with ^{51}Cr-tagged erythrocytes and ^{125}I-labeled albumin. A metallic absorber that is opaque to the soft radiations of ^{125}I permits differential assays of these isotopes with generally available scintillation detection equipment. (auth)

51825 MENINGIOMA FOLLOWING RADIUM THERAPY: CASE REPORT. Feiring, Emanuel H.; Foer, Warren H. (Montefiore Hospital, New York). J. Neurosurg., 29: 192-4(Aug. 1968).

A case of an intracranial meningioma that developed at the site of a cutaneous vascular malformation treated by Ra is reported. At age 30, the woman complained of numbness of the right hand and forearm. Subsequently she experienced a throbbing left frontal headache together with inability to speak on several occasions. Difficulty in writing due to clumsiness in holding a pen was also noted. The patient had an extensive vascular nevus affecting the left frontoparietal scalp and two smaller ones located over the right forehead and dorsum of the right foot. They were effectively treated at the age of two with Ra. A left carotid arteriogram disclosed evidence of a tumor, most probably meningioma, in the suprasylvian region. Craniotomy confirmed the presence of a meningioma. Following operation the patient exhibited a mild expressive aphasia, that rapidly cleared. The relation between the congenital vascular malformation of the scalp, its treatment by irradiation, and the subsequent occurrence of a meningioma directly beneath the site of the original cutaneous lesion is speculated on. The role of irradiation in the development of the meningioma is considered. Many reports suggest that sarcomas may occur as a consequence of radiation therapy. The appearance of such tumors following therapeutic irradiation was observed within brain tissue, in the meninges, and in conjunction with chromophobe adenomas of the pituitary. To the authors' knowledge there is no unequivocal report of a truly benign meningioma induced by irradiation. For this reason they are reluctant to assume that Ra was the responsible factor in the case reported. Nevertheless, the evidence is suggestive and hence this case is recorded to raise the question of a causal relation. (BBB)

51826 TOPICAL 5-FLUOROURACIL FOR ACTINIC KERATOSES. Arnold, Harry L. Jr.; Williams, R. M.; Kim, Robert (Straub Clinic, Honolulu, Hawaii). Geriatrics, 23: 115-17(July 1968).

The use of 5-fluorouracil (5-FU) to treat uv-induced keratoses and prevent development of cancer in these lesions is reported. A 1% solution of 5-FU in propylene glycol applied twice daily for two weeks is effective. The solution is spread thinly over all the exposed skin surfaces of the face, ears, and neck each morning and evening. An excessive inflammatory reaction to the treatment may occur because of some patients' overreactivity, because of exposure to direct sunlight, or rarely, because of acquired contact-type hypersensitivity to either propylene glycol or 5-FU. Severe inflammation may require interruption of the treatment. In such cases, retreatment should not be attempted unless a patch test is negative. In most cases, redness and soreness are apparent by the third day, and increase to maximum, usually by the end of the first week. Patients should not expose themselves to direct sunlight for more than a few minutes at a time, since longer exposure appears to aggravate the inflammatory reaction. Soreness and redness subside within a week after treatment is stopped,

in nearly all cases, and desquamation follows. If the reaction has been a satisfactorily severe one, it leaves the skin smooth and free of actinic keratoses. (BBB)

51827 CYTOGENETIC STUDY OF THE OFFSPRING OF ATOM BOMB SURVIVORS. Awa, A. A.; Bloom, A. D.; Yoshida, M. C.; Neriishi, S.; Archer, P. G. (Atomic Bomb Casualty Commission, Hiroshima). Shizen, 218: 367-8(April 27, 1968).

It is stated that in previous studies no increased frequency of stillbirths, neonatal deaths, or gross malformations was observed. There was also no overall increase in mortality rate in the F_1 generation, and initial impressions of an alteration in sex ratio were not substantiated. These negative findings suggest either that no effects were produced, or that the sample size was too small, or that the indicators used were not sufficiently sensitive. The cytogenetic study described was designed to evaluate the radiosensitivity of human germ cell chromosomes, on the assumption that subtle but detectable chromosomal rearrangements induced in the meiotic chromosomes of an exposed parent would be reflected in the somatic cells of progeny, even if the offspring were phenotypically normal. Criteria in selection were that at least one parent received an exposure dose of >100 rads, and that these were children born both before and after parental exposure. The study involved examination of peripheral blood leucocytes, and karyotype analysis. On the basis of the absence of a radiation effect in 128 children born between 1946 and 1963 it is concluded with 95% confidence, that if there are affected offspring their frequency is <2.5%. (INIS) (UK)

51828 PROTECTION BY ASCORBIC ACID AGAINST RADIATION DAMAGE IN VITRO. Shapiro, Bernard; Kollmann, George (Albert Einstein Medical Center, Philadelphia). J. Albert Einstein Med. Cent., 15: 63-70(Jan. 1967).

Ascorbic acid protection against the radioinduced decrease in lysozyme and aldolase activity, increase in erythrocyte sodium uptake, and reduction in plaque forming capacity of spleen cells from mice sensitized to sheep red cells was studied in vitro. Ascorbic acid protection was studied in three systems: pure enzyme solutions, erythrocyte suspensions, and spleen cell suspensions. The enzyme system consisted of pure solutions of lysozyme and aldolase in which the decrease in enzyme activity after irradiation was measured. Irradiation was carried out by means of a ^{60}Co γ-ray source with a dose rate of 500,000 R/hr. Total doses of 100,000 to 900,000 R were used. Ascorbic acid protected well in the three systems described. In lysozyme and aldolase solutions, it protected even at 5×10^{-4}M concentration. That this was not simply a solute effect was demonstrated by the fact that dehydroascorbic acid did not protect. Dehydroascorbic acid protected only in the erythrocyte system where it presumably was reduced to ascorbic acid by the cells. Chromatography indicated that protection in the enzyme system occurred by radical scavenging but radioinduced protein binding was also observed and may play a role in the protection. (BBB)

51829 TASKS OF MILITARY PHARMACISTS IN THE FIELD OF RADIOBIOLOGY. Gavrila, S.; Bergheanu, S.; Furnica, C. Rev. Sanit. Mil., 71: 315-19(Mar.-Apr. 1968). (In Rumanian).

The work of military pharmacists in radiation research was reviewed. Included was the animal testing of radioprotective agents synthesized such as cysteamine, cystamine, and various salts as well as AET, the markers 2,2,5,5-tetramethyl-3-maleimidopyrrolidine-N-oxide for coupling to various antigens and other biomolecules, combinations of burns and radiation, and experiments with other agents and a number of radioisotopes. (TSS) (JPRS)

51830 THE CASE FOR ^{32}P IN TREATMENT OF POLYCYTHEMIA VERA. Osgood, Edwin E. (Univ. of Oregon Medical School, Portland). Contract AT(45-1)-581. Blood, 32: 492-9(Sept. 1968).

Statistical studies were conducted on the incidence of leukemia in polycythemia patients treated with ^{32}P and x radiation and survival times of ^{32}P treated patients as compared with unirradiated patients. The tabulated results show that early deaths were more numerous in non-irradiated patients than in those treated with ^{32}P. Tables showing survival times of ^{32}P-treated and x-irradiated patients with and without leukemia are also given. Results indicated that patients treated with ^{32}P live about 4 yrs longer than patients treated by other methods. (H.L.W.)

51831 ASSOCIATION OF INTRALYMPHATIC RADIOTHERAPY AND ALKYLATING AGENTS IN THE TREATMENT OF RETROPERITONEAL HEMATOSARCOMAS. Bonadonna, G.; Chiappa, S.; Di Pietro, S.; Marano, P.; Molinart, R.; Uslenghi, C. (Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Nouv. Rev. Franc. Hematol., 7: 381-92(May-June 1967). (In French).

The synergistic action of internal irradiation on chemotherapy is reported for 15 cases with stage IV malignant lymphomas and one case with chronic lymphatic leukemia in which one retroperitoneal lymph node chain was injected with Lipiodol F labeled with ^{131}I (intralymphatic radiotherapy) and the opposite one with unlabeled Lipiodol F. Chemotherapy (N mustard, TEM, cyclophosphamide) was started intravenously 24 hr later. The lymph nodes receiving the double treatment (intralymphatic radiotherapy and chemotherapy) showed in all cases a more marked and long-standing shrinkage in comparison to those treated only with chemotherapy. Nine patients showed, in a period ranging between two and five months, radiological signs of relapse or progression of disease in the lymph chains treated only with alkylating agents, while in only one case the lymph chain treated with Lipiodol F ^{131}I and cyclophosphamide the signs of relapse were observed. Nine patients after three to five months from the first treatment were reinjected bilaterally with Lipiodol F ^{131}I and in all cases a bilateral node shrinkage was documented. Nitrogen mustard at the level of 0.4 mg/Kg intravenously (single dose) seemed to be a more useful drug to produce a rapid and good lymph node regression than cyclophosphamide at the dose of 40 to 60 mg/Kg administered in a fractionated schedule. (BBB)

51832 A STUDY OF RADIATION PROTECTION BY SULFUR COMPOUNDS. Pennington, S. N.; Meloan, C. E. (Kansas State Univ., Manhattan). Radiat. Bot., 8: 345-53(Aug. 1968).

A group of sulfur-containing compounds was investigated to determine if any of these compounds possessed antiradiation character as defined by their ability to protect plant tissue (Lycopersicon esculentum) from the indirect effects of γ radiation. Those compounds containing the S−H group, or that were able to generate this group in solution, were found to afford excellent protection. The ability of these compounds to react with OH radicals was then determined by comparison of the rate constant for a known reaction involving OH radicals with and without the compounds being present. The order of reactivity with OH radicals matched the protecting order found for the radiolysis of plant tissue. (auth) (UK)

51833 THE USE OF ^{90}Sr SKIN PLAQUES IN THE TREATMENT OF PRECANCEROUS AND EPITHELIOMATOUS LESIONS OF THE SKIN. Marani, A.; Putti, C. (Univ., Bologna). Ateneo Parmense, Numero Speciale, 115-32(1967). (In Italian).

Advantages in the use of the β radiation of ^{90}Sr to treat superficial skin lesions over the use of other radiation sources were discussed. At a skin depth of 1 mm the dose falls to about 50% of that at the surface and at 3 mm to about 12%. Dosimetric data are reported for the use of ^{90}Sr plaques 23 mm in dia containing 100 mCi or 16.5 mm dia containing 50 mCi. Skin isodose patterns measured with an anthracene crystal scintillator are shown. Use of the ^{90}Sr applicators to treat nine patients with precancerous skin is described. Single doses of 1000 R were given until total doses of 7000 to 10,000 R were reached. Complete regression of pigmentation and fibrosis of the treated skin was achieved. (BBB)

51834 THE LIVER/THIGH ^{64}Cu RATIO IN WILSON'S DISEASE. Levi, A. J. (Albert Einstein Coll. of Medicine, Bronx, N. Y.); Williams, H. S. Clin. Sci., 34: 379-83(Apr. 1968).

Estimation of the liver/thigh ratio after intravenous injection of 30 to 100 μCi of ^{64}Cu was performed in nine subjects with Wilson's disease, six heterozygotes, and ten subjects with other forms of liver disease. The test was simple to perform but was of no value in distinguishing between presymptomatic homozygotes and heterozygotes for Wilson's disease. These results emphasized the importance of selecting adequate controls before regarding a pattern of ^{64}Cu disappearance as diagnostic of genetic status. (BBB)

51835 SPACE CLINICAL MEDICINE. A PROSPECTIVE LOOK AT MEDICAL PROBLEMS FROM HAZARDS OF SPACE OPERATIONS. Busby, Douglas E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Space Life Sci., 1: 157-427(Aug. 1968).

Medical problems arising from hazards of space operations are described and methods of dealing with these problems in space are suggested. Clinical manifestations, diagnosis, and treatment of space medical problems, such as acute hypoxia, embolism syndrome, decompression injuries, aerosinusitis, dehydration, and hypothermia, are given in detail. Various hazards of space operations are defined and analyzed in order to determine their possible medical effects. Some examples of radiation hazards are as follows: Van Allen radiation, artificial radiation belts, galactic cosmic radiation, radiation sources on spacecraft, solar electromagnetic radiation, solar wind, and solar flares. It is pointed out that the effects of acute ionizing radiation are determined by the different component particles and the energy-flux-time spectra of space radiations. The clinical course passes through four phases: the initial or prodromal phase, the latent phase, the bone marrow depression phase, and the recovery phase. The prodromal phase

is characterized by anorexia, nausea, apathy, and other symptoms that seldom last beyond 48 hrs. The severity of symptoms in this phase correlates poorly with the integral dose of radiation received. It is influenced markedly by individual susceptibility and by psychologic factors. The latent or asymptomatic phase may have a duration of several days. Weakness and fatigue may continue into this phase and epilation usually occurs within two weeks. During the bone marrow depression phase a failure of immune mechanisms occurs, enhancing the body's susceptibility to infectious organisms. During the recovery phase, which lasts from two to several months, repeated infections of the respiratory system and skin may occur. Skin manifestations, including erythema, desquamation, and ulceration, are described with relation to dose. Diagnosis of acute radiation effects in space by hematologic determinations, fluid and electrolyte studies, and other methods is described. The importance of shielding and regulation of the duration of the astronaut's exposure are emphasized as preventive measures. The use of radioprotective drugs is considered impractical owing to their low therapeutic index. The treatment of acute radiation effects using drugs, skin ointments, and blood transfusions is discussed. Over 200 references are listed. (H.L.W.)

51836 A VIEW OF NEUTRON CAPTURE THERAPY: CLINICAL AND EXPERIMENTAL. Farr, Lee E. (Univ. of Texas, Houston). Therapiewoche, 17: 603-11 (1966). (In English and German).

Experimentally it was possible to control and cause permanent regression of a highly invasive, transplantable neoplasm of mice with a single treatment of neutron capture therapy. After injection of boron, the region was exposed 28 min later to a thermal neutron flux of 2.2×10^{12} n/cm^2. The normal tissues were preserved intact. The intensity of the single exposure, and the cell dose required to control the experimental neoplasm of mice appeared to be identical with those required to destroy by a single exposure the intracranial neoplasms of man and to preserve normal cells in the intracranial regions exposed. The further development of this procedure requires further knowledge regarding biological responses to the ^{10}B thermal neutron reaction occurring within cells. (BBB)

51837 THE ACTION OF DMSO (DIMETHYL SULFOXIDE) ON THE REACTION OF THE SKIN TO EXPERIMENTAL IRRADIATION. Kaercher, K. H.; Armbruster, R.; Hornke, I. (Univ., Heidelberg). Ger. Med. Mon., 12: 443-4 (Sept. 1967). (In English and German).

A ^{90}Sr source was applied to the shaved skin on the backs of albino rabbits. The dose rate was 1200 R/min, and the total surface dose was 10,000 R. Dimethylsulfoxide (DMSO) was brushed on immediately after irradiation. Fourteen days after irradiation there were obvious differences in the degree of erosive erythema between the treated and untreated fields. After 36 days there was distinct regrowth of epithelium and hair in the field treated with DMSO. It was concluded that DMSO mitigated the acute radiation reaction and significantly accelerated healing. The rate of healing was further increased by adding the bioflavonoid trihydroxyethylrutoside, while addition of prednisolone potentiated the irradiation reaction. (TSS)

51838 REPAIR REPLICATION AND DEGRADATION OF BROMOURACIL-SUBSTITUTED DNA IN MAMMALIAN CELLS AFTER IRRADIATION WITH ULTRAVIOLET LIGHT. Cleaver, J. E. (Univ. of California, San Francisco). Biophys. J.; 8: 775-91 (July 1968).

Ultraviolet irradiation of HeLa cells, in which bromouracil (BU) was substituted for thymine in one strand of the DNA elicited responses that occurred predominantly in the BU strand. Slight degradation of both strands occurred but the BU strand was degraded to a greater extent than the normal strand. Large uv doses (1000 erg/mm^2) induced degradation of about 1.7% of the DNA within 6 hr of irradiation of unsubstituted cells; in BU-substituted cells under these conditions about 1.9% of the normal strand was degraded but 17.5% of the BU strand. After irradiation, fresh bases were inserted into the BU strands at infrequent intervals throughout the DNA and this was presumed to represent repair of uv damage in the BU strands. After 1000 erg/mm^2 most (70%) of the thymidine incorporated entered the BU strand. Inhibitors of normal DNA synthesis, hydroxyurea and arabinosyl cytosine, did not inhibit the repair of DNA. The increased radiosensitivity of mammalian cells that contain BU may consequently be due to damage of the BU strand. A specific interference between BU and repair of DNA that leads to large amounts of DNA degradation in bacteria did not seem to be important in the sensitization of mammalian cells with BU. (BBB)

51839 COMPARISON OF RADIATION RESPONSE OF THREE MAMMALIAN SPECIES FED DIETS WITH AND WITHOUT BARIUM SULFATE. Burroughs, Sarah Elizabeth. Berkeley, Calif., Univ. of California, 1967. 60p.

Thesis.

Swine, rats and guinea pigs were fed diets with or without barium sulfate for at least ten days before and continuously after total body exposure to ^{60}Co-γ radiation. Results showed that survival times of irradiated swine fed purified diets with and without barium sulfate did not differ. No differences in gastrointestinal response were noted. That barium sulfate in the diet failed to protect swine against radiation injury could have been due to the fact that a purified diet was used. However, studies in which rats were fed a conventional stock diet with and without barium sulfate, as well as the two purified diets used in the swine studies, confirmed that in the rat, mortality following 800 rad whole-body irradiation was reduced in the presence of barium sulfate irrespective of basal diet. Marginal protection against 400 rad irradiation of guinea pigs was detected in one experiment. In rats, protection from barium sulfate could be due to local shielding in the gastrointestinal tract. In swine and guinea pigs, the nature of radiation death following a minimally lethal dose differs and little or no benefit of dietary barium sulfate was exhibited due to significant variation between species. (TSS)

51840 POLYCYTHEMIA VERA TERMINATING IN ACUTE MYELOGENOUS LEUKEMIA WITH FIBROSIS OF BONE MARROW: CASE REPORT. Hoshino, Takashi; Kawasaki, Sho; Okada, Hiromu; Yamamoto, Tsutomu; Kimura, Kazuo (Atomic Bomb Casualty Commission, Hiroshima. Atomic Bomb Casualty Commission, Nagasaki). Nippon Ketsueki Gakkai Zasshi, 30: 16-29 (Apr. 1967).

The patient, who was exposed to atomic bombing in Hiroshima in 1945, was first examined in 1950. The case was diagnosed as polycythemia vera, and the symptoms and course of the disease were followed until death in 1967. Complications of the disease were myelofibrosis and acute leukemia; the relation of these symptoms to myleran therapy is discussed. The effects of uterine myoma and of atomic bomb exposure on the development and course of polycythemia vera were excluded. (H.L.W.)

51841 ENDOLYMPHATIC THERAPY FOR MALIGNANT MELANOMA. Edwards, J. M.; Kinmonth, J. B. (St. Thomas's Hospital Medical School, London). Brit. Med. J., 1: 18-22 (Jan. 6, 1968).

Techniques, results, and complications of ^{131}I endolymphatic treatment of malignant melanoma are presented. Therapeutic lymphography was done two to three weeks after excision of the primary tumor, using a dose of ^{131}I-Lipiodol aimed at 40 to 45 mCi in 4 ml of Lipiodol for the lower limb and 30 to 35 mCi in 2 ml for the upper limb. Most of the radiation effect due to ^{131}I was obtained from the β-particle emitted by the isotope. The penetration of these particles was to a maximum of 2 mm in tissue, with a mean of 0.3 mm. The dose was correlated with histological analysis of block-dissection specimens. The radiation received by lymph nodes with this dose was calculated by direct measurement of excised nodes to be up to 100,000 rad/g. The average spillover to the lungs, measured by external scanning, was about 12% of the dose. Repeated scans showed more rapid elimination from lungs than from nodes. The spillover can be still further reduced by keeping the lower-limb injection volume to 4 ml or less. Long-term studies showed no lung-radiation effects on clinical examination, radiology, or lung-function tests even in patients receiving multiple injections. The dose aimed at was based on studies with animal tumors and on experience with patients where it was found that such doses were tolerated without complications. Total scanning of the patient with a mobile scintillation counter was made 48 hr after the procedure, and repeated scans were carried out to study the rate of elimination of the isotope from the two main areas of uptake, lymph nodes and lungs. The complication rate of endolymphatic therapy was low. In one patient a radionecrotic ulcer developed that needed excision and skin grafting. There was no mortality from therapy or any undesirable after-effects. Occasionally there was transitory pyrexia of 1 to 2°C in the early postoperative phase. Hypothyroidism as a result of thyroid uptake of ^{131}I did not occur. Lymphedema of the infused limb was of mild degree. (BBB)

51842 PARTIAL INHIBITION OF THE LASER REACTION IN MAN BY TOPICAL CORTICOSTEROIDS. Goldman, Leon; Kitzmiller, K. W. (Univ. of Cincinnati). Life Sci., 5: 2215-24 (Dec. 1966).

Previously it was not possible to find Caucasian patients with normal skin reactive to 38 J/cm^2 on a target area of 0.05 mm^2 with 1 msec duration of a pulsed ruby laser. Test subjects included laser research personnel and patients who had received repeated high-energy laser radiation for malignancies. An individual work-

ing in laser research was made reactive to impacts of low-energy normal mode ruby laser. The energy level at the beginning of the experiments was 100 J/cm^2. His minimal reactive dose was found to be 38 J/cm^2. Partial inhibition to the delayed papular response of his laser skin reaction was seen after topical applications of 0.2 and 0.025% fluocinolone acetonide, but not by 0.01% fluocinolone acetonide. Occlusive dressings with 0.01% fluocinolone acetonide and 0.1 and 0.4 mg of fluorandrenolone acetonide per 100 cm^2 of an occlusive tape were also effective. The failure of inhibition of the petechial phase of the delayed inflammatory response to the laser was not explained. No capillary fragility or abnormal petechial response to trauma were demonstrated. (BBB)

51843 EFFECT OF GIBBERELLIC ACID ON THE LESIONS PRODUCED IN GUINEA PIGS BY SUBLETHAL X IRRADIATION. Schwartz, E.; Laginova, V. (Krajska Nemocnica Tuberkulozy, Podunajske Biskupice, Czech.). Bratislav. Lek. Listy, 46: 470-7 (Oct. 31, 1966). (In Slovak).

Guinea pigs were treated for 14 days with gibberellic acid (10-mg/ml doses injected intraperitoneally daily) and then irradiated with a sublethal dose of x rays (400 R at 17.6 R/min). To evaluate the effect of gibberellic acid on the onset and evolution of radiation disease the following criteria were followed: survival time; body weight of the guinea-pigs before and after the experiment; the weights of the liver, the kidneys, and adrenals; and bacteriological findings in the lungs. The results showed that gibberellic acid positively influenced survival time and the body weight of the irradiated animals. The lung parenchyma of the irradiated guinea pigs treated with gibberellic acid showed reduced pathogenic microbial flora in the lungs in comparison with control animals. The bacteria examined included Staphylococcus aureus, Streptococcus hemolyticus, Diplococcus pneumoniae, and Klebsiella pneumoniae. (BBB)

51844 USE OF ^{125}I- AND ^{51}Cr-LABELED ALBUMIN FOR THE MEASUREMENT OF GASTROINTESTINAL AND TOTAL ALBUMIN CATABOLISM. Kerr, Robert M. (Bowman Gray School of Medicine, Winston-Salem, N. C.); Du Bois, John J.; Holt, Peter R. J. Clin. Invest., 46: 2064-82(Dec. 1967).

A new method was developed for the simultaneous measurement of gastrointestinal protein loss and total albumin turnover entailing the use of a combination of ^{125}I- and ^{51}Cr-labeled albumin. Radiation doses to various organs were also calculated. Albumin turnover was determined by the measurement of albumin-^{125}I plasma decay and cumulative urinary excretion. Gastrointestinal catabolism was calculated from the rate of fecal excretion of ^{51}Cr and the specific activity of plasma albumin-^{51}Cr. These data were related to the calculated albumin turnover results. From six to 14 days after administration, the ratio of specific activities of albumin-^{125}I and -^{51}Cr in plasma and in extravascular spaces or gastric and biliary secretions remained almost identical. Fecal excretion of ^{51}Cr was also stable at this time. In six normal subjects gastrointestinal catabolism accounted for less than 10% of total albumin catabolism. The total accumulated dose from ^{125}I was calculated to be 0.086 rad. Total dose to liver from ^{51}Cr was 0.81 rad and to the spleen 2.3 rad. (TSS)

51845 RADIOTHERAPY OF ANAL CARCINOMA. Kunkler, P. B.; Das, R. N. (Velindre Hospital, Cardiff, Wales). Proc. Roy. Soc. Med., 61: 628-9(June 1968).

Optimal radiation techniques for the prevention of radioinjury and its occurrence in a series of 42 patients treated for anal carcinoma are described. The reputation for radioresistance of adenocarcinoma may have to be reconsidered in the light of evidence derived from the treatment of rectal adenocarcinoma. The tradition of radioresistance of adenocarcinoma has been based on experience acquired at a time when high-energy radiation was not available. The perineal tissues are notorious for intolerance to radiation and it is difficult to achieve adequate dosage in very advanced local lesions without the incidence of necrosis. For the plaque-like lesion limited in its upward extent and predominantly to one side, a single-plane Ra implant, with surgery in reserve, appears best in terms of survival and preservation of function. Local tissue tolerance sets the limit on the prescribed dose in irradiation of the anus. One case of local necrosis occurred in this series after a dose of 5500 R in 100 hr from a single-plane implant. One case developing a fibrous structure required a sphincterotomy following a dose of 5500 R in 158 hr. How the results of radiotherapy may be further improved are discussed. First, Ra needles are inflexible and of predetermined length and care has to be taken not to pass too deeply at the external sphincter. This sometimes results in undesirable tissue tension. The use of flexible radiotantalum sources of variable length aims at overcoming this difficulty. Secondly, and particularly for the more bulky lesions, concomitant use of hyperbaric oxygen might improve the results of external beam therapy. (BBB)

51846 TREATMENT OF VAQUEZ'S DISEASE BY RADIOPHOSPHORUS. Vallee, G. (Groupe Hospitalier Necker-Enfants-Malades, Paris). Cah. Coll. Med., 7: 235-40(Apr. 1965). (In French).

The safety and side-effects of ^{32}P as used to treat polycythemia were examined. The nature of the disease was discussed, especially the types of polycythemia that responded to ^{32}P and those that did not. The mode of action of radiotherapy with ^{32}P was described. Dosage should be closely determined, so that the ^{32}P should not excessively destroy erythropoietic tissue and thus allow for the normal production of red blood cells. For calculation of the tissue dose of ^{32}P, the energy of β radiation, the half life of ^{32}P (14 days), the concentration of ^{32}P by bone marrow, the volume of erythropoietic tissue, and rate of excretion of ^{32}P were all considered. Normally 1 μCi of ^{32}P per 10 Kg of body weight was administered. Complications which might occur included thrombocytopenia or leukopenia (from the second to eighth weeks) or anemia (third to sixth month). With the proper doses these side-effects were temporary and not serious. If the red cell count did not return to normal after one treatment, another treatment could be given with half the initial dose. Occasionally, vascular accidents occurred as a result of ^{32}P and could terminate fatally. Another late cause of death in some patients was acute leukemia, believed to be induced by ^{32}P. Other malignant diseases of blood-cell-forming organs have developed following ^{32}P treatment. It was concluded that while ^{32}P therapy might be helpful initially, it had to be used with caution in later stages of polycythemia. (BBB)

51847 RADIOISOTOPE RENOGRAM IN RENAL ARTERIAL HYPERTENSION. Maxwell, Morton H.; Lupu, Andrei N.; Taplin, George V. (UCLA Medical Center, Los Angeles). J. Urol., 100: 376-83(Oct. 1968).

Renal arterial hypertension is the most prevalent form of curable high blood pressure and can be diagnosed only by means of renal arteriography. The literature was reviewed on the use of sodium iodohippurate ^{131}I renograms for this purpose. A critical analysis of the theoretical and practical value of this method is given. (C.O.)

51848 THE INFLUENCE OF GRAFTING OF ISOLOGOUS BONE MARROW ON THE REGENERATIVE PROCESSES IN THE THYMUS OF IRRADIATED MICE. Evsyukov, V. I. (Kirov Military Medical Academy, Leningrad). Byull. Eksp. Biol. Med., 65: 107-9(Jan. 1968). (In Russian).

Regenerative processes in the thymus of x-irradiated mice (700 R) were studied in the CC57W strain treated with isologous bone marrow. The animals without bone marrow grafts showed that restoration on the 7th, 10th, and 36th days after irradiation at the expense of their own sources of regeneration was inhibited. Administration of isologous bone marrow to irradiated mice led to an increase of regenerative processes in the thymus of experimental animals. The gland showed evidence of reparation seven days following irradiation after the stimulating influence of injected isologous bone marrow. (auth)

51849 SYNTHESIS OF BATYLOL. Markova, Yu. V.; Zenkova, L. N.; Shchukina, M. N. (All-Union Chemical Pharmaceutical Research Inst., Moscow). Med. Prom. SSSR, 5: 7-10(May 1965). (In Russian).

Synthesis of batylol, an octadecyl ester of 1,2-isopropylideneglycerol, and its radioprotective effects in animals or humans are reported. Its protective and therapeutic effects were first demonstrated by experiments in rats poisoned with benzene and treated with bone marrow lipids mixed with α-batylol alcohol which restored leukopoiesis and prolonged survival time of the rats. Batylol alcohol also found wide acceptance in clinical tests as a highly effective compound in treatment of leukopenia. Clinical radioprotective treatment with batylol alcohol showed that in most patients radiotherapy could be continued without reducing the prescribed doses and or increasing the time between fractions. Treatment with batylol was recommended for use during telegamma or x irradiation to prevent development of radiation sickness. Batylol was orally administered in 0.02-g doses twice a day as a preventive radioprotective agent and three times a day for treatment of radiation sickness. Batylol could be combined with other agents promoting leukopoiesis when massive doses of radiation were given and in cases where repeated radiotherapy was necessary. A course of treatment was effective from four to six weeks duration. (BBB)

51850 THE INFLUENCE OF THE PREPARATION MUMIE ON THE LYMPHOPOIESIS IN ACUTE RADIATION SICKNESS. Rogozkin, V. D.; Tukhtaev, T. Byull. Eksp. Biol. Med., 65: 110-11(Jan. 1968). (In Russian).

The administration of the preparation mumie in a dose of 500 mg/kg from the first to the 20th day after γ irradiation (SD_{65})

stimulated lymphopoiesis in acute radiation sickness in rats. This was manifested by a more rapid restoration of the number of lymphocytes in the peripheral blood, bone marrow, and spleen of animals treated. The preparation mumie produced some stimulating influences on erythropoiesis, mostly in the restorative stage of acute radiation sickness. (auth)

51851 ACTION OF X-RAYS ON THE LEUKEMOGENESIS OF AKR MICE: THE ROLE OF A GENERAL LESION OF THE HEMATOPOIETIC SYSTEM. Jullien, Pierre; Rudali, Georges (Institut du Radium, Paris). Int. J. Cancer, 2: 245-55(May 15, 1967). (In French).

Mice of the AKR strain were irradiated 1, 8, 15, and 22 days after birth (175 R total irradiation). In these animals, lymphoid leukemias appeared at the age of 5 months, as opposed to 8 months in unirradiated mice. Injection of isologous bone marrow after the last irradiation had no influence on the accelerated appearance of the leukemias. Irradiation of the anterior half of the body only was also capable of accelerating the appearance of lymphoid leukemias. In contradiction, in C3H mice, the injection of isologous bone marrow after a series of irradiations did prevent the appearance of leukemia, and partial body irradiation was not leukemogenic. Injection of either C3H or AKR bone marrow to F_1 hybrid mice (AKR × C3H), irradiated under the same conditions as AKR mice, diminished the appearance of leukemias to a limited extent at the age of 5 months. Those F_1 hybrids which, after irradiation and subsequent injection of AKR bone marrow, did not become leukemic at the age of 5 months, developed leukemia originating from the AKR cells at a later age. Some newborn (AKR × C3H)F_1 hybrids were injected with AKR bone marrow after the irradiation (175 R); the three following irradiations were carried out after the bone marrow preparation had been administered. In these animals, leukemia, originating from the injected AKR cells, appeared at the age of 5 months. (auth)

51852 THE USE OF ^{55}Fe IN HIGH-RESOLUTION RADIOAUTOGRAPHY OF DEVELOPING RED CELLS. Orlic, Donald (Harvard Medical School, Boston). J. Cell. Biol., 39: No. 1, 201-8(Oct. 1968).

It was demonstrated that particles originating in ^{55}Fe foci are sufficiently localized to permit high-resolution radioautographic analysis of red cells viewed in thin sections. This localization was shown first with the use of remnants of hemolyzed reticulocytes as structurally defined sources of ^{55}Fe label and, in a second aspect of the work, by the examination of immature erythroid cells in splenic red pulp. (C.O.)

51853 ANTIRADIATION COMPOUNDS. XI. SULFUR-CONTAINING DERIVATIVES OF NITRILES AND AMINONITRILES. Foye, William O.; Kauffman, Joel M. (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci., 57: 1614-16(Sept. 1968).

Attempts to obtain iminothio esters and dithio esters from α-aminoacetonitrile gave stable products only with the amino group acylated by the carbobenzoxy function. An iminothio ester derived from β-aminopropionitrile was found to be relatively stable as the dihydrochloride, however. Examples of both α- and β-cyanoalkylthiosulfates were found to be stable as the sodium salts. Antiradiation testing of the β-amino iminothio ester dihydrochloride and the α-cyanothiosulfate in x-irradiated mice showed no protective properties. (auth)

51854 EARLY RADIATION LETHALITY: ENZYME RELEASE AND THE PROTECTIVE ACTION OF SOYBEAN TRYPSIN INHIBITOR. Stearner, S. Phyllis; Azuma, Steven A. (Argonne National Lab., Ill.). Proc. Soc. Exp. Biol. Med., 128: 913-17 (July 1968).

Soybean trypsin inhibitor (SBTI) can act to reduce early γ radiation lethality (<24 hours) in the 3-day chick as well as in the 14-day chick embryo. Plasma acid phosphatase activity was increased more than 2-fold in lethally irradiated chicks, but only small increases were demonstrated in groups that received near-lethal exposures or that were protected by SBTI before a lethal exposure. (auth)

51855 ULTRASHORT-LIVED RADIOISOTOPES FOR VISUALIZING BLOOD VESSELS AND ORGANS. Yano, Yukio; Anger, Hal O. (Donner Lab. of Medical Physics and Biophysics, Berkeley, Calif.). J. Nucl. Med., 9: 2-6(Jan. 1968).

The advantages of radioisotopes with very short half lives for visualizing veins, chambers of the heart, and lungs by radioisotope scanning are discussed. It is pointed out that when a radioisotope with a half life of a few seconds is injected intravenously, most of the activity dies away during the first complete transit of the circulatory system. The tracer can be administered as a continuous infusion while a scanner or camera takes a picture of the resulting steady-state condition. The technique also allows the use of slower imaging devices such as positron cameras or scintillation scanners rather than the faster gamma cameras. Radioisotopes with ultrashort half lives are most easily obtained by decay from a long-lived parent. Preliminary methods are described for obtaining ^{191}Ir (4.9-sec half life) from ^{191}Os and ^{109}Ag (39-sec half life) from ^{109}Cd. Methods for the rapid chemical separation and injection of the radioisotopes in dogs are described. Applications in human diagnostic problems are discussed. (C.H.)

51856 PHYSICAL SPECIFICATION OF A GAMMA CAMERA. Westerman, B. R.; Glass, H. I. (Hammersmith Hospital, London). J. Nucl. Med., 9: 24-30(Jan. 1968).

The performance of a gamma camera is specified quantitatively in terms of practical definitions of sensitivity, resolution, uniformity, and linearity. The effect of various relevant parameters such as radiation energy on these quantities is presented. (auth)

51857 TRIPLE-TRACER TECHNIQUE FOR MEASURING RED-BLOOD-CELL, PLASMA, AND EXTRACELLULAR-FLUID VOLUME. Albert, S. N.; Hirsch, E. F.; Economopoulos, B.; Albert, C. A. (Washington Hospital Center, Washington, D. C.). J. Nucl. Med., 9: 19-23(Jan. 1968).

A practical method for measuring red-cell, plasma, and extracellular-fluid volume using three tracers, ^{51}Cr, ^{125}I, and ^{35}S as sulfate, is described. An anthracene cell was designed that greatly simplifies measuring ^{35}S in liquid samples. Measurements obtained in man and dogs are presented. (auth)

51858 ASSESSMENT OF THYROID FUNCTION AND ANATOMY WITH ^{99m}Tc AS PERTECHNETATE. Atkins, Harold L.; Richards, Powell (Brookhaven National Lab., Upton, N. Y.). J. Nucl. Med., 9: 7-15(Jan. 1968).

The trapping function of the thyroid can be studied with ^{99m}Tc-pertechnetate. The accuracy in diagnosing hyperthyroidism is comparable to that with the 24-hr ^{131}I uptake measurement. Suppression of TSH by exogenous thyroid medication and stimulation of the thyroid by TSH administration affect the ^{99m}Tc uptake in a similar way to the effect on ^{131}I uptake. Superior thyroid scans can be obtained with ^{99m}Tc because of its favorable physical characteristics and because large amounts of activity can be administered safely. Therefore the use of ^{99m}Tc-pertechnetate is recommended both for physiological and anatomical studies of the thyroid. (auth)

51859 CHLORMERODRIN-^{197}Hg BRAIN SCANNING: SELECTING THE OPTIMAL INTERVAL BETWEEN ISOTOPE ADMINISTRATION AND SCANNING. Rhoton, Albert L. (Mayo Clinic, Rochester, Minn. Mayo Foundation, Rochester, Minn.). J. Nucl. Med., 9: 16-18(Jan. 1968).

Twenty-five patients with abnormal uptake on brain scans made with chlormerodrin-^{197}Hg were studied to determine the optimal interval between isotope administration and scanning. Twenty patients had tumors, and five had cerebral infarcts. Eighteen of the 20 tumors had optimal tumor-to-non-tumor ratios of counting rates 3 to 5 hr after injection. All five cerebral infarcts were optimally displayed 3 to 5 hr after injection. None of the counting times was extended beyond 5 hr. (auth)

51860 ANTIRADIATION COMPOUNDS. X. DERIVATIVES OF 3,3-DIMERCAPTOACRYLONITRILE. Foye, William O.; Kauffman, Joel M. (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci., 57: 1611-13(Sept. 1968).

The dipotassium salt of 2-cyano-3,3-dimercaptoacrylonitrile was found to give fair protection to mice exposed to x rays. Derivatives prepared for further radioprotective evaluation include dialkyl thioethers, metal complexes, and fused heterocyclic dithioles. A series of 3,3-dimercaptoacrylonitriles bearing aromatic and heterocyclic rings was also obtained from the condensation of arylacetonitriles with carbon disulfide in the presence of alkoxide ion. Of these various derivatives, the zinc complex and the benzoyl derivative showed some radioprotective properties. (auth)

51861 EXPERIMENTAL TREATMENT OF ACUTE RADIATION SICKNESS. Pospisil, J.; Sonka, J.; Dientsbier, Z.; Dostal, M.; Mraz, J. pp 200-19 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

No successful causal treatment of the acute radiation sickness is known, since the pathogenesis has not been fully elucidated. Symptomatic treatment of cases, in which the applied whole-body irradiation dose was smaller than a dose resulting in death proved to be successful in experimental animals. The administration of antibiotics prevented the occurrence of infections. Streptomycin and antibiotics of tetracycline-type were found to be most suitable. The therapeutic effect of streptomycin was verified in experiments carried out in dogs, however, it was not proved in experiments with mice and rats. In the irradiated animals substantial changes of the reactivity of the organism, which may have a great

clinical significance, were observed, and these changes have to be considered in medical treatment. It was found that the level of penicillin in the blood and organs of the irradiated rats was substantially lower as compared with the non-irradiated animals. Transfusion of blood or of the blood components belongs to one of the most important parts of the complex therapy of the acute radiation sickness. The efficacy of blood transfusion in the course of acute radiation sickness depends upon the time of administration, on the degree of the disturbed organism, and on the correctness of the applied procedures. Transfusion of whole blood and erythrocytes exerts the optimum effect on recovery. Transfusion of plasma is suitable during the whole course of the radiation sickness. Transfusions of separated leukocytes are useful during the period of maximal leukopenia, however, the efficacy is not significant. Blood platelets decreased bleeding. Whether the administration of a greater amount of blood in the course of a short time interval or smaller amount of blood more frequently, was studied experimentally in dogs. Administration of a greater amount of blood in longer time intervals was found to be more successful. A favorable effect was increased by simultaneous administration of calcium gluconicum. The therapeutic effect of various vitamins upon the course of radiation sickness was investigated. Nicotineamide and L-ascorbic acid were found to have favorable effects. With cobalamine, riboflavine, and thiamine non-constant effects were observed. Pyridoxine (B_6), which is supposed to affect the post-irradiation syndrome, decreased the survival of irradiated animals. The importance of therapeutic effects of hormones has not been satisfactorily explained. It is without any doubt that thyroxine reduces symptoms of radiation sickness. Glucocorticoids and estrogens were found to have no effects. Antihistaminic preparations as a part of complex therapy favorably affected the treatment of radiation sickness. Different preparations affecting the function of nervous system were tested. The administration of barbital and ammobarbital did not result in negative effects in the course of radiation sickness in spite of the fact that changes of the reactivity of the organism occurred. Single or frequently repeated administration of morphine in analgesic dose did not significantly affect the survival of irradiated rats. Suitable food is an important part of the therapy of acute radiation sickness. The food should be rich in calories and nutrient substances, and easily digestible, with optimum content of protein of biological origin and important vitamins. In experiments, which were carried out in dogs, a favorable effect of diet which contained mainly beef liver was proved. Diversity of clinical appearances of acute radiation sickness and unknown mechanism of the action hinders the possibility of therapeutic solution of this sickness by means of a single preparation, however, a complex of appropriate medicaments (antibiotics, vitamins, hemotherapy, suitable system of nutrition and antihistaminics) may favorably affect the course of radiation sickness. (auth)

51862 IMPLICATIONS OF THE LOW ENERGY OF THE β-PARTICLES FROM TRITIUM. pp 9–11 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The fact that tritium is a low-energy β-emitter must be taken into consideration when dealing with the isotope. Therapeutically, its low-energy permits great accuracy in its localization in biological material. Its narrow range of effective emission makes its use on a subcellular level practicable. Diagnostically, there are limitations imposed on scanning procedures by its short range emission (regular G-M counters are virtually useless here). Handling and storage problems and hazards are unique also for this low-energy β-emitter. (E.R.B.)

51863 UNIVERSITY OF IOWA COLLEGE OF MEDICINE CLINICAL PATHOLOGIC CONFERENCE NO 470: THYROTOXICOSIS, ^{131}I TREATMENT, PULMONARY EDEMA. Sheets, Raymond F. (University Hospitals, Iowa City, Iowa). J. Iowa Med. Soc., 57: 133-46(Feb, 1967).

The possibility that therapy of thyrotoxicosis with ^{131}I might cause excessive release of thyroid hormone from the irradiated gland which might cause myocardial impairment in patients with heart disease was considered, with reference to a case history. A 56-yr-old woman with shortness of breath and chest pain of two weeks' duration was given a therapeutic dose (2.4 mCi) of radioiodine. Two and a half days later, she suddenly developed pulmonary edema and died six hr later. The immediate cause of her death was myocardial failure, with acute pulmonary edema that might have resulted from the excessive action of thyroid hormone on a myocardium already impaired by coronary insufficiency. Patients were known to experience exacerbation of thyrotoxicosis following radioiodine therapy, presumably as the result of an increased release of thyroid hormone into the blood stream. However, radioiodine was given to many other patients with severe cardiac failure and thyrotoxicosis. All recovered, and none had unwarranted reactions to ^{131}I. These data demonstrated that radioiodine could be used safely, and that for the person who had hyperthyroidism and congestive failure, a therapeutic dose of radioiodine should be started as quickly as possible, followed by Lugol's solution and other antithyroid drugs, depending upon the clinical situation. (BBB)

51864 EXPERIMENTAL THERAPY OF ACUTE RADIATION SICKNESS. Mraz, J.; Tkadlecek, L.; Smid, A.; Moravek, F. pp 220-37 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Attempts were made to solve the problem of experimental therapy of acute radiation sickness by means of the application of bone marrow. Experiments with rats showed that the therapeutic effect of homologous bone marrow following x radiation appeared after the applied dose of LD_{60} (600 R). After irradiation with the superlethal dose (800 R) the therapeutic effect was manifested no longer. The greatest effect was found after irradiation with a dose LD_{95-100} (700 R). Antibiotics significantly stimulated the effect of marrow therapy only after the irradiation with very high doses. The administration of homologous bone marrow increased the recovery of bone marrow blood-formation. Cell formation was significantly higher in experimental animals as compared with controls. In the white component of the peripheral blood up to seven days after the administration of the bone marrow no significant recovery was observed as compared with the controls. After the administration of heterologous bone marrow a stimulation of marrow blood-formation occurred. However, it was substantially smaller than after the application of homologous marrow. The radioactivity of $DF^{32}P$ and ^{51}Cr bound to the marrow cells of the donor in peripheral blood, lungs, and liver, dropped very rapidly being exponentially dependent on the time interval. The process of $DF^{32}P$ excretion by the urine and excrements appeared to be analogous; in the bone marrow the activity of $DF^{32}P$ and ^{51}Cr was relatively stable, in the spleen it was constant and relatively very low. The differences between the results obtained by measuring radioactivity in the mentioned organs after the application of $DF^{32}P$ and ^{51}Cr were not significant. Degenerative processes, caryorhexis, mitotic activity with typical mitoses, layers in livers where blood is formed, reparative and necrobiotic processes and several postmorphological phenomena of postirradiation damage were observed after 3–14 months following irradiation with a high dose in rats treated with bone marrow and antibiotics. (auth)

51865 METOCLOPRAMIDE IN CANCEROLOGY. Reboul, J.; Tessier, J. P.; Ferro, P. (Hopital Saint-Andre, Bordeaux). Sem. Hop. Paris, 41: 1795-7(June 20, 1965). (In French).

The treatment of mild radiation sickness in 48 patients, undergoing anticancer therapy with x rays, with metoclopramide (N-(diethylaminoethyl)-2-methoxy-4-amino-5-chlorobenzamide dihydrochloride) is reported. Some of the patients were receiving anticancer chemotherapy with methotrexate or fluorouracil in addition to x radiation. In the first group of subjects receiving combined treatment, with anorexia, nausea, vomiting resulting from x irradiation, metochlopramide was given in 40- to 60-mg oral doses or 20- to 40-mg intramuscular or intravenous doses daily. Vomiting ceased in all cases and nausea was prevented in all but 2 of the 20 cases in this group. In a second group receiving the same type of anticancer therapy, prophylactic treatment with metoclopramide, 6 10-mg tablets per day orally, then 4 tablets per day, entirely prevented nausea and vomiting in all instances. In a third group of patients with severe gastroabdominal cancer, metoclopramide was effective in 8 out of 12 cases. This drug is recommended as a preventive agent for gastrointestinal effects of radiotherapy with and without chemotherapy. (BBB)

51866 ^{131}I TREATMENT OF HYPERTHYROIDISM: ANALYSIS OF 369 CASES TREATED WITH THE INITIAL DOSE OF 15 mCi OR LESS. Yang, Hsueh-fang (National Taiwan Univ. Hospital, Taipei). T'ai-Wan i Hsueh Hui Tsa Chih, 66: 429-40(Sept. 28, 1967).

The incidence of complications and clinical results in 369 cases treated with an initial dose of 15 mCi or less of ^{131}I are compared with those in a previous report of treatment of 348 cases with initial doses of 7 mCi or less. The 15-mCi dose of ^{131}I was calculated according to thyroid weight and thyroid uptake of 100 μCi of ^{131}I retained in each gram of thyroid tissue. When the calculated dose was below 15 mCi that calculated dose was given, and when the calculated dose exceeded 15 mCi a maximum of 15 mCi was given as the initial dose. Among 369 cases, 322 were treated with calculated doses of <15 mCi and 47 cases were treated with 15 mCi. Among 322 cases treated with the calculated dose below 15 mCi, 79 were treated with <7 mCi and

243 cases with the dose >7 mCi. Although calculated doses were based upon the same principle, the one-dose cure rate of patients treated with >7 mCi (34.2%) was definitely lower than that of patients treated with <7 mCi (55.7%). The one-dose cure rate obtained in this series was the same as that obtained in the author's previous series in which 348 cases of diffuse toxic goiter received an initial dose of 7 mCi or less. In the previous series, when the calculated dose was <7 mCi, the calculated dose was given and when it exceeded 7 mCi the limited dose of 7 mCi was given. The one-dose cure rate was 56.5% in patients treated with the calculated doses below 7 mCi, 34.6% in patients treated with the fixed dose of 7 mCi, and 40.8% in all patients. It was suggested that the regimen of ^{131}I treatment for diffuse toxic goiter should be as follows: When the calculated dose was less than 7 mCi, the calculated dose should be given; When the calculated dose was more than 7 mCi, the limited dose of 7 mCi as the initial dose should be given and followed by an additional dose three months later if indicated. (BBB)

51867 ACID PHOSPHATASE AND ACID DEOXYRIBONUCLEASE OF RETICULOENDOTHELIAL CELLS OF THE RAT AFTER IRRADIATION AND TREATMENT WITH DNA. Bankowski, Z.; Polowiec, Z.; Steplewski, Z. (Inst. of Experimental Pathology, Warsaw). Ann. Histochim., 13: 25-32(Jan.-Mar. 1968). (In French).

Female Wistar rats aged seven months were irradiated with ^{60}Co γ rays at a dose rate of 5 R/min for a single whole-body dose of 900 R. Highly polymerized DNA from calf thymus was administered for three successive days beginning 12 hr after irradiation in a total dose of 9 mg. Histochemical techniques were used to detect acid phosphatase and DNAase II in the liver, spleen, and lymph nodes 5, 12, 20, and 28 days postirradiation. Radioinduced atrophy of lymphatic tissues was accompanied by proliferation of fibroblasts and increased numbers of plasma cells, along with signs of a sinusoidal inflammatory response. Twelve days postirradiation the numbers of Kupffer cells in liver had increased; at 20 and 28 days their number was double that of controls. Regeneration of the lymphatic tissues was more rapid in DNA-treated rats than irradiated controls, but stimulation of the reticuloendothelial system was more intense in these controls. (BBB)

Radiation Effects on Animals

Refer also to abstracts 51303, 51306, 51335, 51349, 51353, 51356, 51357, 51360, 51369, 51375–51377, 51384, 51385, 51388, 51394, 51395, 51397, 51403, 51409, 51418, 51428–51431, 51433, 51439, 51441, 51445, 51450, 51451, 51456, 51457, 51473, 51474, 51477–51481, 51483–51485, 51492, 51494, 51517, 51519, 51521, 51533, 51537, 51544, 51545, 51571, 51572, 51575, 51592, 51611, 51670, 51680, 51689, 51699, 51703, 51724, 51726–51728, 51732, 51734, 51735, 51740, 51743, 51747, 51756–51758, 51760–51764, 51766, 51768, 51770, 51772, 51774–51776, 51786, 51795–51797, 51799, 51810, 51811, 51813, 51815, 51816, 51819, 51820, 51825, 51827, 51829, 51830, 51835–51841, 51850, 51851, 51854, 51860, 51867, 52085, 52092, 52114, 52120, 52122, 52124, and 52491.

51868 (ABCC-TR-0-67) BIBLIOGRAPHY OF PUBLISHED PAPERS OF THE ATOMIC BOMB CASUALTY COMMISSION. (Atomic Bomb Casualty Commission, Hiroshima (Japan)). June 1968. Contract AT(49-1)-Gen-72. 7p. (In English and Japanese). Dep. CFSTI.

Fifty references of published papers of the Atomic Bomb Casualty Commission are presented. Subject and author indexes are also included. (B.G.D.)

51869 (AED-C-04-31) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 04: RADIATION EFFECTS ON LIVING TISSUES AND ORGANISMS. Stahlhofen, Wolfgang (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). June 1968. 182p. (In German and English). Dep.

A bibliography is presented of radiation effects on living tissues and organisms. The bibliography is comprised of titles from conferences, dissertations, patents, reports, journal literature, and books. There are also author, report, and subject indexes. (E.R.B.)

51870 (COO-1669-4) STUDIES ON THE MECHANISM OF THE EFFECT OF IONIZING RADIATIONS ON THE OLFACTORY SYSTEM. Progress Report, January 1, 1968-September 1, 1968. Cooper, Gary P. (Cincinnati Univ., Ohio. Coll. of Medicine). Sept. 25, 1968. Contract AT(11-1)-1669. 36p. Dep. CFSTI.

The effects of x rays on the olfactory system were examined. X rays, delivered to the head in anesthetized, tracheotomized rats, were employed as an olfactory stimulus. The response to x ray of, single neurons in the olfactory bulb, were studied as a function of the oxygen concentration of gas used to perfuse the nasal cavities. Results supported the hypothesis that the stimulation of the olfactory system by x ray was an indirect effect within the olfactory mucosa, one that probably was potentiated by the presence of oxygen. The effects of high-dose x-irradiation of the rostral head region on olfactory response to odor was also examined in anesthetized rabbits. The results unequivocally supported the following statements: The large sinusoidal potentials recorded from the surface of the olfactory bulb induced waves as a result of strong odor stimulation were completely abolished by x-ray doses in the 50 to 70 kR range. The responses of single olfactory bulb units to odor may persist for some time after doses just sufficient to abolish the induced waves, but they too were abolished acutely by small additional doses of x ray. The failure of olfactory bulb response to odor was primarily a result of damage within the bulb itself rather than to an effect on the receptor apparatus, since the gross electrical response of the olfactory mucosa and single receptor responses to odor could still be obtained after x-ray doses as great as 95 kR. (C.O.)

51871 (JPRS-45744) COMMUNIST CHINESE SCIENTIFIC ABSTRACTS NO. 2. Translation of Abstracts of Papers from China Zoological Society's 30th Anniversary Scientific Conference, Peking, July 8-18, 1964. 500p. CFSTI.

Abstracts of papers presented at the 30th anniversary scientific conference of the China Zoological Society are presented. The following papers are included among the abstracts: Effects of Ionizing Radiation on the Development and Morphology of Schistosoma japonicum; An Immunological Experiment of Irradiation of Swine Ascaris Eggs with ^{60}Co γ Radiation; Damage of X Ray to the Femoral Bone Marrow Cell Chromosomes of Large White Mice; A Comparative Study of Bone Marrow Cell Chromosome Abnormalities of Small White Mice Following One Exposure and Several Exposures of the Same Dosage of X Ray; Effect of the Dosage Rate on Chromosome Abnormalities Following In Vitro X Irradiation of Human White Blood Cells; Radiation Sensitivity of the Human Peripheral White Cell in In Vitro Conditions; X Ray Action on Male Germinal Cells of Small White Mice; Effects of Direct and Indirect X Irradiation of Germinal Cells of Macaca mulatta; Cytogenetic Observation of the Testicles of Macaca mulatta Following One Irradiation and Several Cumulative Irradiations With X Rays; Histological Observation of the Testicles of Macaca mulatta Following One Irradiation and Several Cumulative Irradiations With X Rays; The Effects of Different Doses of ^{60}Co γ Irradiation During Different Stages of Pregnancy in Small While Mice on the Development of the Progenes; and A Study on X-Radiosensitivity of Female and Male Gametes of Gold Fish. (E.R.B.)

51872 (LA-3848, pp 62-74) MAMMALIAN RADIOBIOLOGY SECTION. (Los Alamos Scientific Lab., N. Mex.).

Four papers and seven abstracts of publications and manuscripts describe the scope of the research in the mammalian radiobiology section. Included among the projects are: low-dose γ radiation effects on performance of monkeys, and on resistance of mice as a function of age; concept of effective residual dose and studies in dogs and monkeys; observations on consecutive generations of progeny from x-irradiated mice; repopulation recovery of erythrocytes, and variations in survival time in γ-irradiated mice; and radiobiological factors in manned Space Flight. (E.R.B.)

51873 (LA-DC-9528) EXPOSURE OF SUBHUMAN PRIMATES TO LOW DOSE-RATE GAMMA IRRADIATION. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 26p. (CONF-680410-3). Dep. CFSTI.

From Symposium on Dose Rate in Mammalian Radiation Biology, Oak Ridge, Tenn.

Rhesus monkeys were trained to perform tasks motivated by both avoidance and reward. Once trained, the animals were subjected to a 30-day test, during which time they were required to work six hrs and were allowed to rest six hrs alternately throughout the test period. The first ten days were used to obtain base line performance data. This was followed by ten days of γ-ray exposure with four monkeys each receiving either 0, 500, 750, or 1000 rads. The final ten days without γ-ray exposure were used to look for delayed effects. Monkeys were tested again (with no γ-ray exposure) following a 60-day rest period to study possible residual effects. The results showed a reduction in food and water consumption in the early phase of γ-ray exposure, returning rapidly to normal, and showing no residual effects. Performance was maintained at base line levels in the animals surviving γ-ray exposure. The hematological response of rhesus monkeys undergoing protracted exposure to γ rays was studied. The parameters followed were erythrocyte count, packed cell volume, hemoglobin, total white cell count, and differential count. The results, shown by means of graphs,

indicated dose- and/or dose rate-dependent differences among the three irradiated groups. (auth)

51874 (ORAU-106, pp 5-104) STUDIES IN RADIATION AND RELATED TOPICS. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The Medical Division devotes a major share of its resources to problems related to radiation. We seek not only for improved therapeutic uses of radiation, but also for better management of unwanted radiation injury. Our mission thus includes both mechanisms of radiation injury and its treatment. In pursuit of these objectives we carry out studies in hematology, experimental radiotherapy, immunology, cytogenetics, and pathology. These studies yield research results often extending beyond the subject area of the original objective. The human total-body irradiation program this year has initiated radiation exposures in the new low-exposure-rate total-body irradiator (LETBI). The observations are adding to our knowledge of the role of dose rate in response to radiation and especially in the responses of patients with certain hematopoietic disorders. The observations are also providing information of importance to the program of the National Aeronautics and Space Administration. Our interest in preventing or correcting damage caused by radiation includes studies on infections and hemorrhagic manifestations. A long-range goal is to develop techniques that allow treatment of radiation injury by hemopoietic grafts; for this reason animal studies are supported in the homograft problem and management of complications of homologous disease. (auth)

51875 (TID-4060(1st Ed.)) RESEARCH AND DEVELOPMENT IN PROGRESS: BIOLOGY AND MEDICINE. (Division of Biology and Medicine (AEC), Washington, D. C. Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Sept. 1968. 523p. Dep. CFSTI.

Indexes prepared by Division of Technical Information Extension.

Abstracts of 1748 research projects conducted in 1967 under contract with the Division of Biology and Medicine, United States Atomic Energy Commission are presented. The following areas of investigation are represented in the projects: the somatic effects of radiation and related repair mechanisms; the metabolism and toxicity of radioisotopes; the genetic effects of radiation at the molecular through the population levels; radioprotective substances, recovery mechanisms, and removal of radioactivity; molecular and cellular level studies; terrestrial and fresh water ecology; marine biology and oceanography; atmospheric radioactivity and fallout; radiological and health physics; radiation instrumentation; metabolism and toxicity of chemicals; nuclear weapons effects studies; research in the metabolic, diagnostic, and therapeutic aspects of cancer; animal, medical, and plant related applications of nuclear energy; and radiation pasteurization of food. Contractor, principal investigator, and subject indexes are included. (E.R.B.)

51876 (UCID-15325) QUANTITATIVE EVALUATION OF THE BIOLOGICAL HAZARDS OF RADIATION ASSOCIATED WITH PROJECT KETCH. Anspaugh, Lynn R.; Robison, William L. (California Univ., Livermore. Lawrence Radiation Lab.). May 8, 1968. Contract W-7405-eng-48. 17p. Dep. CFSTI.

Results are presented of calculations that pertain specifically to Project Ketch (assumed whole-body dose of 0.008 millirads to a population of one million persons) and that are based on risk factors that are derived and explained. These calculated estimates of the genetic, leukemogenic, and carcinogenic effects to this human population are summarized. (B.S.L.)

51877 ERYTHROPOIETIC PROTOPORPHYRIA: PHOTOSENSITIVITY PATTERNS IN MAN AND LABORATORY ANIMALS. Baer, R. L.; Miles, W. J.; Rorsman, H.; Harber, L. C. (New York Univ., N. Y.). Dermatologica, 135: 5-10(1967).

Erythropoietic protoporphyria, an inborn error of protoporphyrin metabolism usually transmitted in an autosomal dominant genetic pattern, is characterized by marked photosensitivity occurring in the long wavelength (400 nm) uv range. This closely corresponds to the absorption spectrum peak of the protoporphyrin molecule. The uv-induced protoporphyrin sensitivity was studied in 8 patients and in guinea pigs. Animals were exposed to irradiation from a bank of 4 Westinghouse Black Light tubes for 3 hr. A 3-mm window glass filter was used to exclude radiation below 3200 Å. The target-skin distance was 12 cm, and the energy emitted was 1000 $\mu W/cm^2$. All animals were examined for erythema 24 hr after irradiation. Marked erythema occurred at the exposed sites in all 6 animals which had received injections of protoporphyrin IX. No reaction occurred at sites shielded from irradiation in the protoporphyrin IX-injected animals or in any sites in the control of animals. Clinical and lab findings in the 8 patients with erythropoietic protoporphyria are reported. Erythropoietic protoporphyria in man is discussed. All cutaneous abnormalities reported to date as occurring in this disease can be attributed to a photosensitivity mechanism. (BBB)

51878 LOW DOSE THERAPY OF HYPERTHYROIDISM. Tezcan, U. P.; Frelick, Robert W.; Meckelnburg, Rober L. (Wilmington Medical Center, Del.). Del. Med. J., 39: 142-6 (June 1967).

Aside from the theoretical hazard of the induction of cancer, leukemia, or genetic changes, the most serious drawback to ^{131}I therapy is the development of permanent hypothyroidism. The incidence of hypothyroidism following ^{131}I is $\sim^1/_3$ in long term follow-up. Low dose therapy did not seem to reduce the incidence in 120 patients followed over a 12 yr period. Such problems as juvenile hyperthyroidism, pregnancy, massive glands, and excessively radioresistant thyroids may require other forms of treatment. (BBB)

51879 SOME CURRENT CONCEPTS CONCERNING ACCELERATED AGING. Anderson, Robert E. (Univ. of New Mexico, Albuquerque). Southwest. Med., 47: 14-16(Jan. 1966).

Irradiated animals die at an earlier age than their nonirradiated contemporaries from a variety of causes often apparently completely unrelated to acute radiation injury. The tumorigenic action of radiation does not completely explain the decreased longevity observed in irradiated animals. They exhibit a linear decrease in life expectancy, an increased degree of arteriolocapillary fibrosis with the passage of time, a slowly progressive generalized decrease in physiologic function involving multiple organ systems, and a temporally related increase in the decrease of malignancies. Biochemical alterations, demonstrated in persons with no other known morphologic, clinical or chemical indication of previous exposure to significant amounts of ionizing radiation, strongly suggest the possibility of accelerated aging among proximally exposed survivors of the atomic bomb. This conclusion is only valid, however, if the hexosamine : collagen ratio represents a true parameter of aging. (BBB)

51880 RADIATION AND AGING. Curtis, Howard J. (Brookhaven National Lab., Upton, N. Y.). Symp. Soc. Exp. Biol., 21: 51-63(1967).

Aging was defined as an increasing probability for the individual to contract a degenerative disease. It was shown that most if not all these diseases probably involve one or more mutations in a somatic cell. Radiation is the most effective mutagenic agent known and also hastens the appearance of all degenerative diseases. Further, different kinds of radiations and exposures to them shorten the life-span of mice by an amount proportional to the number of mutations each of these treatments produce. These facts strengthen the mutation concept of aging and promote the idea that radiation accelerates the aging process. The entire process of aging may be considerably broader than the pragmatic definition adopted here. If all the various age-related phenomena are considered, many of them appear to be unaffected by even large doses of radiation. Thus aging is a complex biological process, and no single, simple theory will explain it, and no single agent could possibly be expected to affect all parts equally. (BBB)

51881 RESPONSES OF CULTURED CHINESE HAMSTER CELLS TO ULTRAVIOLET LIGHT OF DIFFERENT WAVELENGTHS. Todd, Paul; Coohill, Thomas P.; Mahoney, Judith A. (Pennsylvania State Univ., University Park). Contract AT(30-1)-3834. Radiat. Res., 35: 390-400(1968). (NYO-3834-2).

Cultured Chinese hamster cells, line M3-1, were exposed to ultraviolet light from a large water-prism monochromator. Wavelengths used ranged from 2300 to 3664 Å. The ability of single cells to form visible colonies was assessed, and survival curves so obtained were found to be qualitatively similar in the wavelength range 2481 to 2923 Å, with all curves having extrapolation numbers of about 4 ± 1. The maximally effective wavelength was found to be in the vicinity of 2700 Å, and the action spectrum exhibited a broad maximum from 2500 to 2800 Å. Fractionated exposures to 2652-Å and 2803-Å light gave similar dependencies of colony-formation survival on the time elapsed between two exposures. Exposure to light (200 ergs/mm^2) of 2537 Å, 2652 Å, and 2803 Å resulted in long lags in cell multiplication, and nonsurviving cells apparently failed to divide. Of the wavelengths used, light of 2652 Å was maximally effective in delaying cell multiplication. The results were interpreted as indicative that the same group of photon-absorbing molecules was responsible for the inhibition of colony development at all wavelengths used and that proteins as well as nucleic acids may be involved. (auth)

51882 BIOLOGICAL EFFECTS OF UV-RADIATION GENERATED WITHIN THE LIVING ORGANISM. Rusznyak, I.; Naray, Zs.; Ormai, S.; Palkovits, M.; Csaki, L. (Hungarian Academy of Sciences, Budapest). Experientia, 24: 863-4(Aug. 15, 1968).

A method was developed for producing uv-radiation in cavities and organs of a living body. Crystals of CaF_2 were sealed in quartz tubes; these were surgically introduced into the intestine of rats. The rats were subjected to 120 R doses of x radiation and the effects of the uv radiation emitted from the CaF_2 on the intestines were determined; histological techniques are described. The intestinal fragments subjected only to x-radiation showed moderate histological damage. In those parts exposed to the combined action of x rays and uv radiation, i.e., in the places where the tubules containing CaF_2 crystals were located, far more severe damage was observed. It was concluded that uv irradiation of internal organs in vivo was possible by the application of external source of radiation. (C.O.)

51883 INTRODUCTION TO RBE. Fritz-Niggli, Hedi. pp 160-4 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The determination of RBE is a rather complicated problem. Besides the difficulties in the measurements, the following remarks should be added: the RBE depends on the system in which the reactions take place and on the reaction itself. It is possible that healthy tissues have a different RBE than cancerous tissues, the RBE depends on the dose rate and on the total dose, and the RBE depends on the stage of development and the physiological conditions of the cell. In our mutation experiments with drosophila we could show that those stages of developments that depend on LET also demonstrate the effect of oxygen and a dependency on the time factor. A reaction model demonstrates among other things that fast electrons can be less efficient because of the lack of energy concentration. (auth)

51884 DEPENDENCE OF RBE ON EXPERIMENTAL OBJECT AND THE OBSERVED REACTION. Wachsmann, Felix. pp 165-7 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

The relative biological effectiveness (RBE) of 5 MeV electrons was determined, based on the effects of 180 kV x rays. The RBE was different, in relation to the effects in the number of reticulocytes following whole-body irradiation of the mouse, than in relation to the effects on rat spermatocytes. The conclusion was drawn that the observed reactions and particularly the RBE for 5 MeV electrons were dependent upon the type of tissue being irradiated. (E.R.B.)

51885 ON THE PROLONGED CULTURE OF HUMAN DIPLOID CELLS IN VIEW OF PHARMACOLOGICAL RESEARCH. II. COMPARISON OF GROWTH CHARACTERISTICS, X-RAY SENSITIVITY, AND ANTIMITOTIC CHEMICAL COMPOUNDS IN A DIPLOID STRAIN (L 809) AND A HETEROPLOID LINE (HeLa). Deyssan, Guy; Adolphe, Monique; Cheymol, Jean (Faculte de Medecine, Paris). Ann. Pharm. Franc., 26: 193-205(Mar. 1968). (In French).

The x-radiosensitivity of normal human fibroblast diploid cells (L 809) and cancer cells (HeLa) was studied. Comparative observations were made of cell doubling time, mitotic index, the cell cycle, coefficient of cell proliferation, and RNA metabolism. A cellular suspension was irradiated with 250-kV x rays at doses of 300, 500, and 700 R, and examinations were made 2, 4, 7, 9, 11, 14, and 18 days after irradiation. The L 809 strain showed more binuclear and polynuclear cells, whereas the HeLa strain showed a greater tendency toward giant cell formation; otherwise reactions of both cell strains were similar. Study of mitotic frequency revealed differences in the behavior of the two cell types. Mitotic depression was greater in L 809 cells at all doses. The proportion of mitotic anomalies caused by x rays was about the same for both types of cells, considering the number of abnormal mitoses in control HeLa cells. It was concluded that no significant distinction could be made between the two strains of cells with regard to radiosensitivity or response to various antimitotic chemical compounds. (BBB) (TSS)

51886 ON THE EFFECT OF X IRRADIATION ON THE SKIN OF RATS: ELECTROPHORETIC AND CHROMATOGRAPHIC INVESTIGATIONS. Rodermund, O. E. (Univ., Bonn). Arch. Klin. Exp. Dermatol., 231: 318-28(Apr. 23, 1968). (In German).

Changes in skin proteins were studied in rats subjected to soft (29-KV) x rays in fractionated doses of 1200 to 12,000 rad or to a single dose of 20,000 rad. Electrophoretic, immunologic and amino acid fingerprinting analyses were performed on the extracts of irradiated skin. Results are compared with those seen in untreated skin and in serum. It was shown that at the doses of x rays used, changes in collagen occurred that were demonstrable soon after irradiation. The changes appeared to involve slight changes in the structure of the collagen molecules rather than extensive degradation of the molecules. (TSS) (BBB)

51887 DIGESTIVE LESIONS FOLLOWING ANTICANCER TREATMENT EXCEPTING CORTISONE (PHYSICAL AND CHEMICAL AGENTS). Payan, H.; Dupont, A.; Potet, F.; Demaille, A.; Lebreuil, G. (Faculte de Medecine, Marseille). Laval Med., 37: 367-86(Apr. 1966). (In French).

Digestive lesions resulting from accidental or excessive irradiation, as well as those caused by chemical agents, are discussed. The incidence of such injuries varied from 1 to 50% according to the patients series reported. Most gastrointestinal lesions occurred during the first year after irradiation. Treatments by Ra, x rays, and more recently by high-energy irradiation (^{60}Co and betatron) and radioisotopes (^{198}Au by intraperitoneal injection) were all involved. The most common treatment to result in gastric radioinjury was that for uterine cervical cancer (89%); others were for retroperitoneal (6%), pelvic (2%), and other internal (3%) tumors. The segment most commonly injured was the rectosigmoid (89%); others were the small intestine (5%), stomach (3%), and miscellaneous areas (3%). Each of these forms of radiation injury is described in detail on the basis of macroscopic and histological findings. The specific nature of the lesions and their distinctness of symptomology from those of the original tumor treated by irradiation are analyzed. Factors inherent in radiotherapy that may affect the development of lesions are discussed. In general, the total doses of irradiation ranged from 3000 to 5000 R, with 5.7% incidence of injury between 5000 and 6000 R, 14.2% from 6000 to 8000 R, and 21% above 8000 R. For ^{60}Co, serious injuries occurred from 2000 to 5000 R. Problems encountered in dose fractionation and combination therapy are discussed. In conclusion, comparisons are drawn between chemotherapy and radiotherapy injury. (BBB)

51888 DEVELOPMENT OF WATER AND SACCHARIN PREFERENCES AFTER SIMULTANEOUS EXPOSURES TO SACCHARIN SOLUTION AND GAMMA RAYS. Smith, James C.; Schaeffer, Robert W. (Florida State Univ., Tallahassee). Contracts AT (40-1)-2903; AT(40-1)-2690. J. Comp. Physiol. Psychol., 63: 434-8(1967).

The minute-by-minute time course of the development of the aversion to saccharin following exposure to ionizing radiation was studied in 90 Sprague-Dawley rats, ~120 days old at the beginning of the experiment. An electronic drinkometer circuit was used to follow rats that had received saccharin solution, water, or an empty bottle simultaneously with 100 R of γ irradiation from a ^{60}Co source (1.33 R/min). If the preference test was initiated immediately following exposure, all rats developed an aversion to saccharin within the first hour. If initiation of the preference test was delayed 24 hr, only rats that received saccharin during exposure developed the aversion. Sham-exposed rats showed characteristic preference for saccharin solution. Close temporal contiguity between saccharin ingestion and irradiation was a requisite for conditioned aversion to saccharin. (BBB)

51889 CONSEQUENCES OF PRENATAL IONIZING IRRADIATION FOR THE FETUS WITH SPECIAL EMPHASIS ON DIAGNOSTIC IRRADIATION. Gefferth, Karoly (Medical Univ. of Budapest). Orv. Hetil., 108: 2031-3(Oct. 22, 1967). (In Hungarian).

It has recently become known that even correctly performed x-ray examinations can cause radiation damage in the patient herself or in her offspring. One group of damages results from a single, large dose or repeated small doses of irradiation of the organism after conception has occurred. It may result in early fetal death or in various developmental anomalies. The fetus may be born apparently healthy and malignant tumors may appear later. In another group, the damaging effect of radiation is sustained before conception. This may manifest itself in the offspring that develops from the damaged ovum or, by damaging the genetic structure, in some later offspring possibly only in the 6th generation. The consequences are again early death or developmental anomalies. Therefore, it is the duty of the physician to order x-ray studies on young patients only on the basis of most stringent indications and to provide optimal radiation protection; in women of child-bearing age, abdominal x rays should be avoided if possible during the second half of the menstrual cycle. (JPRS)

51890 RADIATION EFFECTS ON THE INNER EAR. Gamble, James E.; Peterson, E. A.; Chandler, J. Ryan (Univ. of Miami, Fla.). Arch. Otolaryngol., 88: 156-61(Aug. 1968).

Auditory function and histologic changes were studied in guinea pigs x irradiated at doses of 500 to 6000 rad. After 6000 rad, the inflammatory reaction at 2 weeks was so severe as to prevent accurate measurement of the cochlear microphonics in all instances. The effects of radiation on peripheral auditory function was as-

sessed by changes in cochlear microphonic potentials. In no animal was there any visible evidence of radiation effect within 24 hr following irradiation. The mucosa of the bulla and middle ear appeared normal at examination with the operating microscope. Within the 24-hr period, there was little or no loss of cochlear microphonic sensitivity, even in the animals receiving higher doses of radiation. However, there was some loss of sensitivity in the lower frequencies. Animals having received 5000 rad exhibited mild erythema of the mucosa in the bulla and the middle ear, and there was a loss of sensitivity, averaging from 20 to 40 db, and occurring primarily in the frequencies above 7000 Hz. Findings at 2 months were similar to those obtained at 2 weeks except that those receiving intermediate doses of radiation, i.e., 3000 rad, demonstrated a comparatively greater loss in sensitivity in the subsequent 6 weeks. There was general increase in the loss of sensitivity in the order of 30 to 40 db at higher doses. Again, the loss was manifested more in the higher frequencies. At 3000 rad and above, changes in the cellular structures of the irradiated cochleae appeared to be directly related to the amount of radiation given. The earliest changes seen were in the stria vascularis. At 6000 rad, these changes became more marked, even to actual shriveling of the hair cells. The tectorial membrane was elevated in animals receiving as little as 3000 rad. These effects on the stria vascularis and organ of Corti were similar to those changes found in a human temporal bone after radiation therapy to the ear. (BBB)

51891 THRESHOLD DOSES FOR CONDITIONED AVOIDANCE BEHAVIOR USING LOW DOSE RATE GAMMA RADIATIONS. LeVan, H.; Haas, R.; Sassoon, H.; Krown, F. (Univ. of Illinois, Chicago). Acta Radiol., Ther., Phys., Biol., 7: 141-7(Apr. 1968).

When mice were exposed to low-dose-rate γ radiations (2×10^{-2} R/min), the threshold dose for the conditioned aversion to 1% saccharin sodium solution was much less than 30 R, and for aversion to 5% sucrose solution, was about 90 R. The degree of avoidance changed with the sweetness of the solution and was a linear function of the accumulated radiation dose. (auth)

51892 THE EFFECT OF A SINGLE INTRAUTERINE X IRRADIATION ON THE POSTNATAL DEVELOPMENT OF THE HIGHER NERVOUS ACTIVITY AND THE ELECTROCORTICOGRAM OF RATS. Klingberg, F.; Pickenhain, L.; Neumeister, K. (Karl-Marx-Univ., Leipzig). Acta Biol. Med. Ger., 10: 503-18(1967). (In German).

Rats were irradiated with 200 R on day 19 of embryogenesis and electrophysiological and behavioral parameters were recorded, such as postnatal development of the background activity of the electrocorticogram (ECG), the amplitude of photically evoked cortical primary potentials (EP), photic after-discharges (PhNe), and photic recruitment (PhR) in the visual cortex as well as the general behavior of the animals, the speed of elaboration of a conditioned escape reflex, and the amplitude of startle reflexes. Compared with unirradiated control animals, the irradiated animals showed retarded development of the ECG (smaller amplitude of the background activity and a strong reduction of synchronized activity), of EP (decreased amplitude of the primary component), of PhNe and PhR (they appeared later and had a smaller amplitude), increased motor activity and an impaired adaptability to changing environmental conditions (retarded formation of conditioned escape reflexes). The intensity of these changes corresponded to the degree of physical underdevelopment of the irradiated animals (body weight and length). Under relatively constant environmental conditions there was some compensation for the described disorders. The observations suggest damage to those mechanisms in the brain which are responsible for the synchronicity of neuronal activity. (BBB)

51893 PREOPERATIVE IRRADIATION IN LARYNGEAL CARCINOMA. Reed, George F. (State Univ. of New York, Syracuse). Arch. Otolaryngol., 86: 318-25(Sept. 1967).

Bases for combining radiotherapy with surgery and the problem of wound healing delay because of irradiation are discussed. The radiation dosage and the time interval between x-ray therapy and surgery are considered. One program calls for low dose radiotherapy in a short period of time, i.e., 2000 to 3000 rad in 1 to 2 weeks followed by surgery in 1 to 2 weeks. The other uses a full cancerocidal dosage of 5500 and 6000 rad with a period of 4 to 6 weeks before surgery. Difficulties of postoperative healing were roughly proportional to the dose of preoperative irradiation. In general, cases that had received small doses (2000 to 3000 rad) followed by immediate surgery had relatively little postoperative morbidity as compared to cases that received full cancerocidal doses followed by surgery 3 to 6 weeks postoperatively. (TSS) (BBB)

51894 EFFECT OF UV IRRADIATION ON THE DEVELOPMENT OF CALVES. Dobrinin, V. V. (Kirov Agricultural Inst., Leningrad). Veterinariya, 42: 61-3(Apr. 1965). (In Russian).

Physiologic and immunologic reactions were investigated in two series (A and B) of experiments on calves. In A series, 30 calves, 10 days old, were divided into 3 equal groups, one group the control. The 2nd group was irradiated from December to May, once every 3rd day, from 4 to 10 hr, with a uv lamp (EUV-30). In addition to this schedule of irradiation, the 3rd group received daily doses of salts of three trace elements: potassium iodide 0.5 to 1.5 mg, cobalt chloride 5 to 10 mg, and copper sulfate 50 mg. Some calves were inoculated with Salmonella enteritidis. General improvement in clinical and physiological conditions of calves, and gain in weight, indicated the beneficial effects of uv irradiation. The B series included 27 calves, in 3 groups of 9 each. They received the same uv radiation treatment and salt feeding as those in the A series, but underwent immunological tests. Three calves, 15 days old, from one group received 2 paratyphoid bacilli injections at 5-day intervals, as did 3 calves 45 days old from the 2nd group and 3 calves 70 days old from the 3rd group. The B series showed an increased phagocytic activity, enhanced ability to produce antibodies, and increased level of plasma proteins, especially albumin and γ-globulins. The uv irradiation increased the natural immunologic reactivity of calves and their specific immunity, but more effective results were obtained by the simultaneous feeding of calves with daily doses of the trace elements. (BBB)

51895 STUDIES ON THE RADIOSENSITIVITY OF THE RAT INCISOR. Koppang, Hanna Stroemme (Univ. of Oslo). Odontol. Tidskr., 75: 413-59(Oct. 25, 1967).

Rats were given single doses 300, 400, 500, 600, or 700 R of 175-KV x rays to the head, some being additionally injected with 10 mg of cysteamine 5 min before irradiation. One to four weeks later the left upper and lower excisors were examined histologically. So-called complete and incomplete lesions were distinguished. Complete lesions consisted of a typical radioinduced niche in dentin. Incomplete lesions referred to less pronounced changes, such as pulpal osteodentin (depolarization dentin) formation combined with reduction in width of the predentin/dentin zone. Single head doses of 300 R were found capable of inducing the formation of complete and incomplete lesions in the superior incisors of rats. In the inferior incisors single head doses of 400 R were required to produce the radioinduced niche; doses of 300 R induced incomplete lesions in some rats. Three and four weeks after irradiation a mushroom-shaped lesion was demonstrated. This observation might be interpreted as an expression of reparative processes. The critical x-ray dose for dentin niche formation was generally not increased by the administration of cysteamine prior to irradiation. A tendency was seen for cysteamine to increase microscopic dental x-ray effects at lower radiation doses and to reduce the radiation effect at higher doses. (BBB)

51896 ON THE EXTENT OF INTESTINAL RADIATION REACTIONS IN RATS AFTER ADMINISTRATION OF VARIOUS HORMONES OF THE VITAMIN B COMPLEX. Schmidt, Wolfgang (Strahleninstitut und der Strahlentherapeutische Klinik, Magdeburg, Ger.). Strahlentherapie, 135: 702-7(June 1968). (In German).

A total dose of 200, 400, 600, 800, 1000, or 1200 R was administered to 624 albino-rats, in groups of 24. The intestinal reactions and the influence on it of Vitamin B_{12} and B_8, of folic and pantothenic acid was studied. After 200 and 400 R no diarrhea was observed in the animals. From 600 R upward, its intensity increased with dose. In the larger mammals, as in guinea pigs, the diarrhea was only observed after moderate and lethal doses and only transiently at the final stage. In the rats, however, this was observed exclusively at the beginning of the radiation sickness and even after sublethal doses. After lethal doses the hematological changes were parallel to the intensity of intestinal reactions and were in most cases precursor signs of the death of the animals from radiation. No influence of Vitamin B_{12} and B_8, folic and pantothenic acid on the diarrhea was observed. (auth)

51897 CLINICAL EVALUATION OF RBE. Ward, H. W. C. pp 213-14 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

From animal experiments, it was determined that the RBE for electrons from a 15 MeV accelerator was 0.86 compared to 250 kV x rays. Clinical applications revealed that this value was too low because of reactions occurring in human skin. Subsequent studies taking into account human skin reactions place the RBE at 0.90 for 15 MeV electrons given at the dose rate of 400 to 500 rads/min. (E.R.B.)

51898 LATE EFFECTS OF BETA-IRRADIATION OF THE LUNGS. Chiarle, S.; Bellion, B.; Garbagni, R. pp 217-22 of

Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

The effect of irradiation with an electron beam on the lungs consists in a connective reaction that also involves the alveolocapillary septum. Apart from this aspect, the lungs show the same cytologic (chromatin and cytoplasmic) changes observed in other tissues. These studies were carried out in rabbits irradiated with a single 4,000 R dose of electrons. Observations were made under the optical and electron microscope. (auth)

51899 DISTANT EFFECTS OF ELECTRON-IRRADIATION. Zuppinger, Adolf. pp 184 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.
See CONF-640918.

The remote influence of local irradiation is briefly described. Examples using calcium-45 uptake studies in the bones of irradiated subjects are discussed. (B.G.D.)

51900 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST ELECTRONS AND BETATRON X RAYS. Morell, Andreas. pp 182-4 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).
See CONF-640918.

For the determination of the relative biological effectiveness rabbits were irradiated with conventional x rays, high-speed electrons and betatron x rays. When equal doses are applied the reaction of the skin is greater in the case of x rays than with high-speed electrons. The value found for the relative biological effectiveness is 0.68 for high-speed electrons and 0.75 for betatron x rays of 30 MeV energy. (auth)

51901 OBSERVATION OF THE IRRADIATION OF EXPERIMENTAL TUMORS WITH FAST ELECTRONS (ELECTROMICROSCOPY). Kaercher, K. H. pp 178-82 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).
See CONF-640918.

The Walker sarcoma of the rat was irradiated with a single dose of 300 R and a total dose of 1200 R of 9-MeV electrons. The applications occurred at intervals of 24 and 48 h. Electron microscopic examinations were made before and after treatment. It was possible to show that the most intense changes in mitochondria and nucleus occurred in the case of a 24 h irradiation rhythm. (auth)

51902 IONIZING IRRADIATION: EFFECTS OF REPEATED LOW-DOSE EXPOSURE. Scarborough, Barron B.; Martin, Joan; McLaurin, William A. (Florida State Univ., Tallahassee). Physiol. Behav., 1: 147-50(1966).

Male Sprague–Dawley rats were given a total dose of 1544 R of x irradiation administered in low daily doses 5 days a week for 9 months. Control animals were sham irradiated for a like period of time. Both groups were required to learn increasingly complex escape patterns in a water maze. The experimental and control groups did not differ in mean number of errors, in weight gain for the period of the experiment, nor in the time they could stay afloat. The results agreed with earlier conclusions that doses of over 1000 R did not interfere with the learning of relatively complex problems in the absence of radiation sickness, which was not evident during any phase of the present experiments. It was concluded that under the conditions of this study low intensity, chronic, intermittent x irradiation exposure had little or no effect on physical endurance, weight gain, or complex problem solving behavior in the rat. However, it cannot be assumed that the biological changes that occur in an organism under radiation exposure have no psychological manifestations. (BBB)

51903 ELECTROLYTE COMPOSITION OF THE BLOOD PLASMA AND SPINAL FLUID IN RABBITS IRRADIATED AFTER PROPHYLACTIC ADMINISTRATION OF CYSTAMINE. Kuzovkov, A. G.; Ivanov, B. M. (Lenin Academy, Leningrad). Radiobiologiya, 8: 425-8(1968). (In Russian).

The content of sodium, potassium, and calcium ions in the spinomedullar fluid and in the blood plasma taken from the carotid artery and medullar venous sinus was studied in experiments on rabbits by the method of flame photometry. The indices of the calcium content reflect the total value of ionized and bound calcium. Irradiation of the animals is accompanied by pronounced hypokalemia and a slightly increased sodium level. Cystamine administered before irradiation normalizes the potassium metabolism in the animal organism after irradiation and somewhat increases the sodium and calcium ion content in the blood in this case. (JPRS)

51904 ACTION OF IONIZING RADIATIONS ON THE COCHLEA WITHIN THE LIMITS OF THE TREATMENT OF ORAL CANCERS. Terracol, Jean; Calvet, Jean; Coll, Joseph. J. Fr. Otorhinolaryngol., 14: 883-8(Dec. 1965).

Experimental and clinical data on radiation effects in the cochlea are reviewed. The effect of radiation exposure of the human cochlea is discussed in relation to treatment of 54 cases of cancers of the nose, ear, and throat area. The patients were male aged 52 to 75 yr and ^{60}Co therapy was used with doses of ~5000 rad. In 66% of cases treated, hearing was not affected. In 27% of cases there was slight impairment of hearing. In 7% there was more severe loss of hearing. It was concluded that in most cases no cochlear lesion is present but that late vascular insufficiency may have resulted in hearing disorders. (BBB) (TSS)

51905 THYROID CARCINOMA AND ITS TREATMENT. Taylor, Selwyn (Royal Postgraduate Medical School, London). Postgrad. Med. J., 44: 404-10(May 1968).

Etiologic factors, particular ionizing radiation, in thyroid carcinoma and the radiation treatment of the disease are reviewed. With ionizing radiation there was no doubt that exposure of the fetal and growing thyroid to even small doses could lead to carcinoma. Clinical data are presented that conclusively show a higher number of carcinomas in those who have received irradiation. Experimental confirmation was found in rats given thiouracil in their drinking water to stimulate hyperplasia and growth of the thyroid and then exposure of the gland to small doses of x rays or radioiodine in the weanling period. The irradiated rats produced more tumors and some cancers. Recently it was shown that rats irradiated at the weanling stage and subsequently fed on a low iodine diet developed thyroid nodules, some of which were frankly malignant, in a much higher proportion than those which did not receive irradiation. The use of ^{131}I and external irradiation to treat thyroid carcinoma is also reviewed. (TSS) (BBB)

51906 DIGESTIVE COMPLICATIONS OF IONIZING RADIATIONS. Viguie, R.; Roberti, A.; Paugam, B. (Centre Hospitalier, Argenteuil, France). Actual. Hepato-Gastro-Interol., Hotel Dieu, 1: 134-43(Apr.-June 1965). (In French).

The sensitivity of the digestive tract to ionizing radiation is discussed. In healthy mucous membranes, x rays can produce radioepithelitis with loss of mucus and regenerative capacity about the 20th day. Gastric lesions are discussed and a probable maximum tolerable dose is estimated as 4000 R administered over a 50-day period. Postradiotherapic ileitis is considered. The small intestine is the most radiosensitive segment of the tract and is highly susceptible to local overdosage. Sigmoid lesions occur most frequently when the large intestine is injured by radiation. Anorectal complications are most often seen after treatment of pelvic neoplasms with 200-KV x rays, ^{60}Co, or Ra. Also discussed are early radioepithelitis, late anorectitis with perirectitis, and complications from irradiation of cancers of the anus and anal canal. Effectiveness of treatment of radioinjury is evaluated, including use of vitamin A, hydrocortisone, and surgery. It was concluded that prevention is of the greatest importance, since treatment is so varied in effectiveness. (BBB)

51907 INVESTIGATIVE STUDIES WITH THE LASER IN THE TREATMENT OF BASAL CELL EPITHELIOMAS. Goldman, Leon; Rockwell, R. James Jr.; Meyer, Robert; Otten, Robert (Children's Hospital Research Foundation, Cincinnati). S. Med. J., 61: 735-42(July 1968).

Effects of various types of laser irradiation on skin and its possible carcinogenic effect are presented. Studies of laser treatment of basal cell epithelioma in 27 patients with 64 lesions have shown that this tumor may be used as a test type for studying the reactions to the laser and its hazards in cancer therapy. The initial therapeutic results were good when adequate target areas and adequate energy and power densities of the lasers were used. Pigmented basal cell epitheliomas and nonpigmented epitheliomas colored by vital dyes and Cu salts showed increased effects of laser treatment. No skin malignancy was observed from repeated laser impacts on investigators or following chronic exposure of laser lab personnel or in personnel working with high output lasers for air pollution studies. Therefore, there are no data that the laser is carcinogenic. (BBB)

51908 RELATIVE BIOLOGICAL EFFECTIVENESS OF PROTONS-660 MeV (STUDY OF THE DAMAGE OF TESTES AND OF GENETIC EFFECTIVENESS). Pomerantseva, M. D.; Ramaya, L. K. (Inst. of Genetics, Moscow). Zh. Obshch. Biol., 25: 302-10(July-Aug. 1964). (In Russian).

The RBE of three types of radiation (660-MeV protons, ^{60}Co γ rays, and 190-KV x rays) was determined using as criteria the degree of testes damage and frequency of induced dominant lethal mutations in mice spermatozoa and spermatids. The proton RBE determined by these indices was 0.45 and 0.6 to 0.7 as compared to x rays and ^{60}Co γ rays, respectively. The values

obtained were of the same order as other indicators of radiation damage, e.g., weight loss, longevity, and red blood cell changes. The RBE of ^{60}Co γ rays when studied by the same indices gave 0.6 to 0.7 in relation to 190-KV x rays. The dependence of the frequency of induced dominant lethal mutations in spermatozoa upon the dose was nearly exponential for the three types of radiation within the dose range studied. Genetically, spermatids were 2.5 times more radiosensitive to the action of 660-MeV protons and ^{60}Co γ rays than spermatozoa. (BBB)

51909 THE ROLE OF THE PHAGOCYTE IN HOST-PARASITE INTERACTIONS. XIV. EFFECTS OF CONCURRENT X IRRADIATION ON PHAGOCYTOSIS. **Mukherjee, A. K.; Sbarra, A. J. (Tufts Univ. Medical School, Boston). RES, J. Reticuloendothel. Soc., 5: 134-46(Apr. 1968). (NYO-3240-22).**

Phagocytosis of Escherichia coli by guinea pig polymorphonuclear leukocytes, as affected by in vitro irradiation, was studied. Low dose x irradiation during phagocytosis led to a significant increase in bactericidal activity. Irradiation along with phagocytosis was shown to influence the intracellular event rather than particle entry. Concurrent irradiation also increased the bactericidal activity of leukocyte homogenates under different conditions. The increased killing was shown to be partially inhibited by catalase and by compounds that are known to compete with free radicals. Continuous or concurrent x irradiation also caused a small but significant increase in the oxidation of glucose-1-^{14}C by phagocytizing cells. These observations were explained on the basis of the assumption that irradiation produces H_2O_2 continuously, through the formation of free radicals, and this excess H_2O_2 in combination with the myeloperoxidase present in the phagocyte enhanced killing of ingested bacteria. (BBB)

51910 CHROMOSOMES AND RADIATIONS: ANOMALIES OF THE CARYOTYPE IN OLD TUBERCULAR SITES TREATED BY PNEUMOTRORAX. Mouriquand, C.; Puech, P.; Patet, J.; Gilley, C. (CEN, Grenoble, France). Compt. Rend. Soc. Biol., 161: 2511-16(1967). (In French).

Twelve persons with histories of tuberculosis that were treated by bilateral pneumothorax eight to 27 yrs before, and who were now in perfect health were examined to determine if the very low x irradiation doses received from radiographic examinations during their therapy had resulted in the continued presence of chromosome anomalies in leukocytes. The aneuploidy observed was not significant. However, in three subjects there was a slight hyperdiploidy. The number of damaged chromosomes varied from 8 to 28% in comparison with the controls at 10.4%. The difference is highly significant. The total number of chromosome anomalies differed in a highly significant fashion from the control samples, but this was not true for the chromatid anomalies. The number of subjects studied was, however, too small to evaluate the eventual risk that these anomalies represent. (tr-auth)

51911 ULTRAVIOLET RADIATION AND LYSOSOMES IN SKIN. Johnson, B. E. (Cornell Univ., New York). Nature (London), 219: 1258-9(Sept. 21, 1968).

Among the more complex membranous components of skin tissue cells lysosomes are the most susceptible to rupture by uv radiation; there is also indirect evidence for lysosomal enzyme action in damage caused by uv radiation to rat skin in organ culture. If lysosomes are disrupted in skin cells exposed to uv radiation in vivo the enclosed enzymes may be released and either bound to natural substrate or removed in the blood; in either case assays for lysosomal enzymes would show less activity in irradiated skin than in controls. This was investigated using mice ears. Dermatological implications, including skin cancer, are discussed. (UK)

51912 LASER TREATMENT OF CANCER. Goldman, Leon (Children's Hospital Research Foundation, Cincinnati). Progr. Clin. Cancer, 3: 205-20(1967).

The mechanism of tissue injury produced by the laser, changes in tissue cultures of cancer cells produced by laser irradiation, and protection of personnel using the laser are discussed. Although the intense light beam of the laser has a thermal component, the thermal reaction cannot be used to explain all the changes that are seen. Laser-induced coagulation necrosis may extend beyond the actual target area, may be delayed for periods of time, and even may be selective as regards color of the target. Controlled clinical investigative experiments with the cautery and high frequency electrosurgery showed different changes in tissue when they were used on selected areas in the same patients. Chromosomal aberrations produced by laser irradiation of cells in tissue cultures suggested that there were also mechanical factors produced by laser irradiation, such as pressure waves and even the production of recoil elastic or sound waves in tissue. Moreover, there may be late tissue changes similar to those caused by ionizing irradiation. This latter feature was suggested by the development of free radical formation and in tissue culture studies by the development of chromosomal aberrations. In studies with x-ray monitoring devices and the cloud chamber, it was not possible to detect the production of x rays. (BBB)

51913 EFFECT OF CYSTEAMINE ON CORDYLOPHORA CASPIA (ATHECATE HYDROID) IRRADIATED WITH X RAYS. Bouillon, J.; Bosschaert, S. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg., 54: 183-9(1968). (In French).

Cysteamine (6 mM) administered before and during x irradiation protects definitively and totally a third to a half of Cordylophora caspia irradiated with a lethal dose of x rays. (tr-auth)

51914 FREE NUCLEOTIDES OF THE LIVER OF RATS IRRADIATED WITH X- AND γ-RAYS. Barbiroli, B.; Pasquinelli, V.; Moruzzi, M. S. (Univ., Bologna). Boll. Soc. Ital. Biol. Sper., 44: 197-200(Feb. 15, 1968). (In Italian).

The comparative effects of x- and γ radiation on the acid-soluble free nucleotides of the liver of rats exposed to increasing radiation doses were studied using male white rats. The animals were exposed to 600, 800, or 1000 R of one of the radiations. The animals were sacrificed and the liver was removed 48 hrs after the irradiation. The results show a general modification of the spectrum of the acid-soluble free nucleotides in the irradiated rats. The nucleotides with energy function are particularly reduced in quantity. The uridilic coenzyme showed significant variations. The results indicate that ionizing radiations cause noticeable injuries to the nucleotide spectrum and suggest that the metabolic modifications observed in the glucides and lipids can be attributed to a large degree to such modifications. (J.S.R.)

51915 BONE MARROW RESPONSE TO ACUTE RADIATION INJURY IN RFM/U MICE AFTER WHOLE- AND PARTIAL-BODY EXPOSURE TO X-RAYS. Wellington, J. S.; Elashoff, R. M.; Ludwig, F. C. (Univ. of California, San Francisco). Int. J. Appl. Radiat. Isotop., 19: 695-702(Sept. 1968).

Whole-body exposure to a given dose of 250-kV X-rays (100 rads or 300 rads) induced greater cell depletion in the left femoral marrow of RFM/U mice than irradiation of the left femur alone. This is consistent with the concept that tissue damage produced by whole-body irradiation is due to combination of direct and systemic injury. It is postulated that the systemic injury results from the suppression of protection afforded by the unirradiated tissues rather than from toxic agents emerging in the irradiated tissues. The loss of the nucleated cells (erythroblasts, lymphoid and myeloid precursor cells, mature myeloid cells) in the marrow of the irradiated left femur was paralleled by an increase in the number of marrow erythrocytes, so that the total count (nucleated cells plus erythrocytes) remained constant throughout the period of acute radiation injury. Both the nucleated cell response and the erythrocyte response were highly dose-dependent. Hence, the ratio of erythrocytes over nucleated cells, which can be estimated from a marrow biopsy, may be useful as a biological dosimeter in estimating the radiation dose received by an individual. (auth) (UK)

51916 IN WHAT AMOUNTS ARE X RAYS RESPONSIBLE FOR THE ORIGIN OF MALIGNANT ILLNESSES IN INFANCY? I. MORPHOLOGICAL CHANGES IN THE HAND SKELETAL PHOTOGRAPHS OF LEUKEMIC CHILDREN. Gefferth, Karl (Univ., Budapest). Strahlentherapie, 135: 670-4(June 1968). (In German).

The hypothesis that radiologic pelvimetry can enhance the risk of malignant diseases in the offspring and that the children show a modified propensity is examined. The radiographs of leukemic children were studied to look for any eventually present inferiority of the connective tissue that could accompany the malignant osseous lesions. Such connective tissue modifications were found 1.5 to 5 times more frequently in leukemic children than in children with other diseases. One could then suppose that in these children a mesenchymal lesion had occurred and that they reacted to a low radiation dose with a malignant disease. The sole responsibility of radiation as a cause of malignancy after radiologic pelvimetry could then be questioned. (auth)

51917 PROSTHETIC EVALUATION OF PATIENTS WHO HAVE RECEIVED IRRADIATION TO THE HEAD AND NECK REGIONS. **Rahn, Arthur O. (Univ. of Kentucky, Lexington); Matalon, Victor; Drane, Joe B. J. Prosth. Dent., 19: 174-9(Feb. 1968).**

Construction of removable partial and complete dentures for patients who have received radiation to the head and neck regions is considered. Osteonecrosis may develop after dentures are inserted over irradiated tissues. However, soft silicone liners used in denture bases are well tolerated by the oral tissue. Before consideration of a patient for dentures, at least 1 yr should elapse after completion of radiotherapy to allow the oral tissue to return to as normal a state as possible. Within 6 to 15 months following

irradiation, a secondary reaction occurs, consisting of edema and fibrosis of the muscles and blood vessels within the fields of exposure. Therefore, often the patient must be re-evaluated after 2 or 3 years. Dentures were made for 50 oral cancer patients who had received irradiation. Only 2 developed necrosis, with involvement of the soft tissue only. When these patients discontinued wearing dentures altogether, the areas healed without complication. Measures to ensure the success of dentures in patients who have received radiation are discussed. (TSS)

51918 ASPERGILLOMA IN A LUNG AFFECTED BY RADIOTHERAPY. Le Tallec, Y.; Delaude, A.; Vadhat, F.; Moreau, G. (Clinique Medicale, Toulouse). J. Fr. Med. Chir. Thorac., 20: 557-65(1966). (In French).

A 58-yr-old female patient was observed who had received intensive radiotherapy after an operation on the left breast in 1954. Radiodermatitis had followed the treatment. Ten years later she was hospitalized for hemoptysis that was present for two years. The diagnosis was generalized aspergillosis of the lung, believed to be a result of the radiation damage. In a second case of this type a 44-yr-old woman had received 2000 R over a four month period for sarcoma of the breast. Seven years later repeated episodes of hemoptysis led to thoracic surgical exploration and detection of radioinduced sclerosis of the lung associated with aspergillosis. Gross and histologic changes (including tortuous, dilated bronchial vessels) occurred. (BBB)

51919 LASER COAGULATION RISKS AND ADVANTAGES. Tengroth, Bjoern (Univ. of Gothenburg, Sweden). Trans. Ophthalmol. Soc. U. K., 86: 55-61(1966).

Effects of laser radiation on the eye and the associated hazards are presented. The relation between exposure time and energy, in particular, was explored. To investigate the relation between light properties and tissue damage, experiments on rabbits were carried out with different types of lasers. A giant pulse laser was used for which the emitted light was concentrated in a single well-defined peak with a duration of 15 to 35 msec. The results showed that there is a regular relation between tissue damage and the so-called peak power. Tissue damage was dependent upon the peak power, i.e., the amplitude of the highest peaks in the train, whereas no such relation existed between mean power and tissue damage or energy and tissue damage. Further investigations were carried out to measure the dependence of the tissue damage threshold on peak power density as the retinal spot size was varied. The results showed that peak power density for the tissue damage threshold was exponentially related to spot size. Whether the coherence of light is of importance or not in laser effects is discussed. Resonance phenomena in molecules, especially in the ribonucleic acids, may occur and cause disruption of chemical bonds. By means of a delicate technique where single retinal cells were placed in a Cartesian microdiver and exposed to a gas laser beam of very low power density, an increase in oxygen consumption was registered after 30 min of exposure. Since the power was such that the rise in temperature would be limited to 0.1°, the coherence of the light beam may be the real reason for this change. The observed increase in oxygen consumption was reversible and within a couple of minutes, normalized. However, if chemical changes occur as a result of the coherence of the laser radiation, delayed effects in the tissues may be expected. These might affect cell reproduction and cause degenerative changes months or even years after a laser coagulation. (BBB)

51920 SOCIAL PROBLEMS OF FALLOUT: THE CONTRIBUTION OF EPIDEMIOLOGICAL STUDIES TO THE SOLUTION OF SOCIAL PROBLEMS. Langmuir, Alexander D. (Communicable Disease Center, Atlanta). Pediatrics, 41: Suppl., 332-41 (Jan. 1968).

Suggestions are made for epidemiological studies on the possible effects of fallout, such as those used to investigate various diseases. It is proposed that a systematic, precise, and sophisticated surveillance of congenital defects on a national, if not international, scale would be valuable if the occurrence of clusters could be related to established patterns of radiation in the environment. The methods that have proved useful in the surveillance of communicable diseases of national importance should be readily adaptable to problems of the surveillance of radioactive fallout and its associated diseases. In a discussion by several participants some specific approaches are mentioned, such as a study of the possible ill effects of high fallout ^{137}Cs levels in Eskimos. Recommendations were made for more epidemiological follow-up on persons, particularly children, who receive clinical administration of radionuclides. An epidemiological study in Nevada and Utah in relation to effects in populations near the Nevada Test Site is referred to. (BBB)

51921 OCULAR HAZARDS OF TRANSSCLERAL LASER RADIATION. I. SPECTRAL REFLECTION AND TRANSMISSION OF THE SCLERA, CHOROID AND RETINA. Smith, Richard S.; Stein, Marvin N. Amer. J. Ophthalmol., 66: 21-31 (July 1968).

The widespread use of high intensity laser devices suggests the possibility of ocular injury from a laser beam transmitted through the sclera. Using human autopsy eyes and pigmented rabbit eyes, the spectral reflection and transmission characteristics of the sclera, choroid, and retina were measured by means of a spectrophotometer. Values obtained over the spectral range from 500 to 2,600 mμ showed little variation among different specimens. Measurements made in human and rabbit eyes were qualitatively and quantitatively similar. The results obtained at 694.3 and 1,060 mμ were confirmed by a second method, using ruby and neodymium lasers as the radiation source. (auth)

51922 OCULAR SPECTRAL CHARACTERISTICS AS RELATED TO HAZARDS FROM LASERS AND OTHER LIGHT SOURCES. Geeraets, Walter J.; Berry, Edward R. Amer. J. Ophthalmol., 66: 15-20 (July 1968).

Ocular spectral characteristics, including transmission through ocular media and reflection and absorption from and within retinal pigment epithelium and choroid, have been given for the spectral range 350 to 1,500 nm. Data on humans, rabbits, and monkeys are compared. The importance of such data with regard to estimations of retinal hazards from high intensity white light and various laser sources is discussed. (auth)

51923 CORNEAL INJURY THRESHOLD TO CARBON DIOXIDE LASER IRRADIATION. Fine, Ben S.; Fine, S.; Feigen, L.; MacKeen, D. Amer. J. Ophthalmol., 66: 1-15 (July 1968).

Rabbit eyes were exposed in vivo to descending-power levels of continuous CO_2 laser irradiation to determine a threshold for injury. Irradiation at a power density of 0.1 w/cm^2 for 30 minutes was found to be noninjurious to the rabbit eye by clinical and histopathologic examinations. Mild suprathreshold injuries were examined to evaluate changes that might occur in the most superficial corneal layers and to serve as a guideline for improved histopathologic evaluation of the threshold and near-threshold injuries. A variety of morphologic changes in the corneal epithelium, epithelial basement membrane, and superficial stroma in suprathreshold and near-threshold lesions are described and discussed. (auth)

51924 ATAXIA TELANGIECTASIA: NEOPLASIA, UNTOWARD RESPONSE TO X IRRADIATION, AND TUBEROUS SCLEROSIS. Gotoff, Samuel P.; Amirmokri, Ebrahim; Liebner, Edwin J. (Univ. of Illinois, Chicago). Amer. J. Dis. Child., 114: 617-25 (Dec. 1967).

A patient with ataxia telangiectasia showed an untoward response to x radiation therapy for a palatal lymphosarcoma. After 3000 rad in 3 weeks to the tumor site, the patient developed a severe dermatitis and deep tissue necrosis resulting in death 8 months later. A fatality resulting from this dose level of radiation is extremely unusual and may be related to the biological defects already described in ataxia telangiectasia. This report calls attention to the possibility of an intrinsic undue susceptibility to irradiation which warrants further documentation and investigative studies, as well as a cautious approach to radiation therapy in this disease. (TSS)

51925 CONCERNING THE ECTOPIC HEMOPOIESIS IN DOGS WHICH SURVIVED AFTER ACUTE RADIATION SICKNESS. Nemenova, N. M.; Malanina, V. N. Arkh. Patol., 30: No. 7, 19-23(1968). (In Russian).

The results of anatomo-pathologic examination of dogs which survived x-ray irradiation in lethal doses are presented. The animals' life span was from two and a half months to 3 years and 2 months. Changes in the bone marrow and lymphopoietic organs were noted in all the animals observed. These changes indicated that complete restoration of the hemopoiesis failed to occur even at periods of 2 years and 10 months and 3 years and 2 months after the irradiation. A number of animals exhibited the presence of ectopic hemopoiesis foci both in the spleen and lymph nodes and in the internal organ vessels (cardiac muscle, liver, lungs). The authors associate the development of extraosseous hemopoiesis in the internal organ vessels with destruction of stem cells in the bone marrow. (auth)

51926 PROBABILITY OF SURVIVAL OF A CELL IN A COMPLEX SYSTEM WHEN IRRADIATED WITH IONIZING RADIATIONS. Gupta, P. C. (Inst. of Nuclear Medicine and Allied Sciences, Delhi). Bull. Math. Biophys., 29: 753-8(1965).

Theoretical expressions for the probability of survival of an irradiated cell were obtained in a simple form. An attempt was made to calculate the probability that a cell will remain in normal condition or in damaged state at a given instant of time. Instead of considering that there is only 1 radiation-sensitive region in the living cell which is the basis of target theory, the author considers that every part of a cell is important for vital function-

ing of the cell. The following assumptions were made in this presentation: the living cell is considered a constituent of n number of sensitive regions; all the sensitive regions are in the same state of radiosensitivity which remains constant throughout the period of irradiation; the cell is considered to be in a damaged state as soon as any one of n sensitive regions is damaged; once the cell is repaired after being damaged, it will behave like a normal cell for further irradiation; and the period of exposure is very small in comparison to life span of the cells. (BBB)

51927 RETICULOENDOTHELIAL ACTIVITY IN NEONATALLY THYMECTOMIZED MICE AND IRRADIATED MICE THYMECTOMIZED IN ADULT LIFE. Schooley, John C.; Kelly, Lola S.; Dobson, Ernest L.; Finney, Caroline R.; Havens, Virginia W.; Cantor, Linda N. (Univ. of California, Berkeley). RES J. Reticuloendothel. Soc., 2: 396-405(Dec. 1965).

The phagocytic capacity of the reticuloendothelial system (RES) was studied in mice in which immunological reactivity was suppressed either by neonatal thymectomy or by a combination of adult thymectomy, whole-body irradiation, and bone marrow transplantation. Male LAF_1 mice were thymectomized or sham-operated within eight hr after birth; female C_3H mice were thymectomized or sham-operated at seven to nine weeks of age. Three weeks later the C_3H mice were γ irradiated (^{60}Co) with 960 R over the whole-body. Immediately after irradiation, 9×10^6 viable bone marrow cells obtained from the femurs and tibias of isologous donor mice were injected intravenously. The phagocytic function of the RES was determined at 70 to 120 days of age in mice thymectomized at birth, and at 30 days postirradiation in mice thymectomized as adults. It was measured by determining the rate of clearance of intravenously injected carbon from the blood. There was no evidence of a hypofunction of the RES in such animals. Indeed, a slight, although not marked, increase in RES activity was observed in adult thymectomized irradiated mice and in neonatally thymectomized mice when compared to controls on an age-weight basis. A marked hyperactivity of the RES was found in mice which developed the runting syndrome following neonatal thymectomy. (BBB)

51928 ESTRIOL EXCRETION AND VAGINAL CYTOLOGY IN NORMAL PREGNANCY DURING RADIATION THERAPY FOR CARCINOMA OF THE CERVIX. Adcock, Leon L.; Cohen, William D. (Univ. of Minnesota, Minneapolis). Amer. J. Obstet. Gynecol., 100: 590-1(Feb. 15, 1968).

Estriol determinations as correlated with vaginal cytology in a pregnant patient with cancer of the cervix treated with irradiation are reported. The patient at ~20 weeks' gestation was found to have an invasive squamous cell carcinoma of the cervix. At 21 weeks' gestation ^{60}Co therapy to the pelvis was started and completed in 4 weeks. The dose was 3300 R. The fetal heart could no longer be heard 2 days before completion of ^{60}Co therapy. On the last day of ^{60}Co therapy, 50 mg of Ra was inserted into the uterus and upper vagina, the total dose being 5000 mg-hr. One week later she was delivered of a macerated male infant weighing 880 g. Twenty-four-hr urine collections and vaginal smears were obtained throughout treatment. The karyopyknotic index remained within normal pregnancy limits throughout the course of irradiation therapy including the time of fetal death. Other cytologic changes of pregnancy, such as clumping and folding of intermediate cells and the presence of navicular cells, persisted. Estriol levels remained consistent with the duration of gestation until 2 days prior to fetal death. Thereafter there was a rapid fall. It is suggested that the effect of radiation was primarily on the fetus rather than the placenta. Thus, progestational effect on the vaginal mucosa persisted even though fetal death was impending or had occurred. Likewise, when the fetal circulation terminated with cessation of placental perfusion, there was an abrupt fall in estriol excretion. (BBB)

51929 ELECTRON MICROSCOPIC STUDIES OF THYMUS GRAFT REGENERATION AND REJECTION. II. SYNGENEIC-IRRADIATED GRAFTS. Blackburn, Will R.; Miller, J. F. A. P. (Univ. of Colorado, Denver). Lab. Invest., 16: 833-46(June 1967).

The cytology of syngeneic, in vitro irradiated, thymus grafts was studied by both light and electron microscopy during the various stages of regeneration. In grafts soon after irradiation and implantation, only epithelial cells, macrophages, and a few large lymphocytes survived. Substructural alterations (including a loss of cytoplasmic inclusions, tonofibrils, desmosomes, and condensation of the mitochondria) were noted in surviving epithelial cells which were transitory in nature. The alterations in thymus epithelium and the observed lag in lymphoid regeneration in irradiated grafts are discussed in terms of previous experiments related to the possible function of thymus epithelium. Five days after implantation, small ultrastructurally characteristic cells were observed within the implant. The evidence which links these cells with previously described pluripotent stem cells (small lymphocytes) of host, and probably bone marrow origin, is presented and discussed. (BBB)

51930 MORPHOLOGICAL CHANGES IN THE THYMUS IN MYASTHENIA FOLLOWING RADIATION THERAPY. Kop'eva, T. N. (Inst. of Human Morphology, Moscow). Arkh. Patol., 30: No. 7, 13-19(1968). (In Russian).

Thymus glands were removed from patients with myasthenia following one or several courses of x-ray therapy. Thymoma was revealed in 9 cases; thymus lesions were benign in the remaining cases. The following changes were detected (with the aid of planimetric and histochemical methods) in the thymus glands of patients following massive doses of x-ray therapy, applied to the thymus region: a marked involution of the gland, accompanied by a fall of the weight of thymic parenchyma (in comparison with non-irradiated glands), dystrophic changes in the epithelial cells, depression of hyperplastic immune reaction and sclerotic processes in the interstitial tissue. Morphological lesions in the tumors, subjected to x-ray therapy, consisted of regression of parenchymatous cells of the tumor, marked sclerosis and hyalinosis of the interstitial tissue. Peculiarities attending histological types of thymoma persisted. (auth)

51931 FLUCTUATION OF RADIOSENSITIVITY DURING THE ONTOGENESIS OF DROSOPHILA MELANOGASTER LARVAE. Csukas-Szatloczky, Iren; Duda, E.; Paradi, E.; Faludi, B. (Eotvos Lorand Univ., Budapest). Acta Biol. Acad. Sci. Hung., 19: 57-64(1968).

The effect of ^{32}P was examined in the 3rd larval stage of Drosophila melanogaster. There was a period of high radiosensitivity between 75 and 100 hr after ovulation. The sensitivity maximum appeared at the larval age, at 95 to 97 hr. The peak of incorporation between 95 and 97 hr was conspicuous only in the first 2 hr; if larvae were kept on ^{32}P-containing medium for 8 hr and tested thereafter, the incorporation appeared to be independent of age. Besides its lethal effect, ^{32}P substantially delayed or inhibited pupation. The observed maximums could not be explained on the basis of the radiosensitivity of a total ontogenetic period, but in terms of the conspicuous sensitivity of some physiological stages. (BBB)

51932 DELAYED RADIATION EFFECTS IN THE BRAINS OF MONKEYS EXPOSED TO X AND γ RAYS. Haymaker, Webb; Ibrahim, M.Z.M.; Miquel, Jalme; Call, Nancy (Ames Research Center, Moffett Field, Calif.). J. Neuropathol, Exp. Neurol., 27: 50-79(Jan. 1968).

Pathogenesis of delayed radionecrosis was observed in the brains of cynomolgus monkeys (Macaca irus). Delayed pathological changes occurred in the brains of monkeys receiving x or γ radiation to the head in a dose of about 2000 R given at 50 R/min. Latency of lesion development was between 13 and 17 weeks. White matter, cerebral cortex, and hypothalamic nuclei were damaged. The widest spectrum of lesion type was found in the white matter. Lesions often developed in relation to altered vessels. Glycogen-laden degenerating oligodendroglia was encountered in early stages of the inception of some of the lesions. Damage to these cells was considered dependent on vascular-circulatory factors. Vascular injury brought about by hemodynamic disturbances was probably the overriding pathogenic factor in the development of parenchymal lesions. (BBB)

51933 ELECTROPHYSIOLOGIC RECORDINGS IN PERIPHERAL NERVE HETEROGRAFTS. Hirasawa, Yasusuke; Marmor, Leonard; Junge, Douglas (Univ. of California, Los Angeles). Arch. Neurol., 18: 445-8(Apr. 1968).

Action potentials were recorded from regenerated nerves in three dogs in a study of various methods of protecting irradiated heterografts. In each animal a 2-cm section of peroneal nerve was resected, and a 4-cm previously irradiated (2 Mrep) human nerve was sutured in place with two or three stitches of 7-0 Nylon suture. Dog 1 received silicone rubber sheaths over the proximal and distal sutures. Dog 2 was treated with sheaths of heterogenous artery (human, 2 Mrep irradiation) over the suture lines. Dog 3 had an autogenous saphenous vein over the suture lines. Each sheath was limited to 1 cm length so as not to inhibit the nutrition of regenerating axons. The compound action potentials obtained by stimulating in the distal segment or at the distal suture line and recording in distal nerve are shown. Conduction was present in the proximal segment in each case. Little inference could be drawn from the response amplitudes regarding the effectiveness of the three types of sheath. The electrical recordings in all three cases, however, confirmed the presence of regenerated nerve fibers. (BBB)

51934 A STUDY OF THE INFLUENCE OF SPATIAL DISTRIBUTION OF IONIZATION ON SKIN CARCINOGENESIS USING PROTON AND ALPHA-PARTICLE BOMBARDMENT. Lippincott,

Stuart W.; Baker, Charles P.; Stickley, E. E. (Medical Coll. of Virginia, Richmond. Brookhaven National Lab., Upton, N. Y.). Contract AT(40-1)-3515. Radiology, 91: 537-9(Sept. 1968). (ORO-3515-5).

The direct effects of ionizing-particle irradiation upon mouse epidermis were investigated using accelerator-produced, monoenergetic, 10 MeV protons and 40 MeV α particles. By placing a rotating filter of variable thickness in the beam, multiple Bragg peaks were delivered in depth in the path of the charged particles through the tissue. In this way a cylinder of skin was subjected to essentially uniform ionization limited to a depth of 1 mm. The dose was 2,000 RADS. At one year post-bombardment no neoplasm occurred in the proton-bombarded groups, but a high percentage of fibrosarcomas developed in the mice exposed to α particles. The density of ionization produced in the tracks of the α particles is about four times that from the protons and appears to be of underlying importance in the induction of the fibrosarcomas. (auth)

51935 UNIFORMITY OF PROTON BEAMS AVAILABLE AT THE NASA SYNCHROCYCLOTRON (SREL). Hill, Gerald F.; Honaker, William C.; Kim, K. H. (Langley Research Center, Hampton, Va.). Radiology, 91: 562-7(Sept. 1968).

The NASA Space Radiation Effects Laboratory (SREL) has the unique ability to produce both small- and large-area beams of protons having energies from 595 MeV to 30 MeV. Dose rates are available over a wide energy spectrum to meet the requirements for radiation biology experiments. All of the large-area beams are uniform and repeatable. Several investigators have used the available large-area beams to irradiate mice, rabbits, and monkeys. (auth)

51936 ACTIVATION OF VARICELLA-ZOSTER VIRUS INFECTIONS BY IMMUNOSUPPRESSIVE THERAPY. Rifkind, David (Univ. of Colorado, Denver). J. Lab. Clin. Med., 68: 463-74(Sept. 1966).

Activation of virus infections by ionizing radiation is reported in patients receiving local radiotherapy for suppression of the rejection reaction following kidney transplantation. There appeared to be a significant temporal association between the use of local x irradiation, either therapeutically or diagnostically, and the onset of zoster. Local x irradiation to the implanted kidney as an antirejection measure was used in 34 patients. In these patients, one or more courses were given in the form of three doses of 150 R each, every other day. In four of the six zoster patients described the initiation of x-ray treatment was followed in 6 to 23 days by the appearance of zoster lesions. In one patient zoster appeared 5 days after diagnostic hip and pelvis roentgenograms. In the sixth patient the zoster was not associated with preceding x irradiation. In the five patients in whom zoster was associated with x ray the lesions arose in proximity to the area irradiated. In one patient the involved dermatome was contralateral to the implanted kidney. The contralateral lesions could be explained on the basis of x-ray scatter to the contralateral dorsal root ganglion. In one case there was concomitant zoster involving the ipsilateral cervical area where x-ray scatter would be minimal. While there was an apparently unique temporal relation between local x irradiation and the onset of herpes zoster in the renal transplant patients, the other immunosuppressive therapy used may have contributed to the high reactivation rate of this infection. (BBB)

51937 MARROW CELL INJURY FOLLOWING ^{45}Ca UPTAKE IN BONE. Barranco, S. C.; Beers, Roland F. Jr.; Merz, Timothy (Johns Hopkins Univ., Baltimore). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 849-55(Aug. 1968).

The effects of ^{45}Ca on the cells of the bone marrow in the rat were studied. Animals in 5 groups received injections of 25 μCi, 50 μCi, 100 μCi, 200 μCi, and 300 μCi of ^{45}Ca, respectively. They were sacrificed at 12 hours, 24 hours, 36 hours, 2 days, 4 days, 6 days, 8 days, 12 days, 19 days, 25 days, and 32 days, and the bone marrow was removed from the tibiae and assayed for damage. The incidence of micronuclei and the changes in the mitotic index were used as an indication of radiation damage to the nucleus. The total β dose delivered in 12 hrs by 25 μCi ^{45}Ca is then only 0.66 RADS per gram of tissue, but the observable effects are considerable. A generally linear increase in micronuclei was observed with increasing activity of ^{45}Ca. Doses as low as 50 μCi produced a 2.92 fold increase in micronuclei. Within the first four days after injection of the isotope, bone marrow from animals receiving a 300 μCi dose showed about 5 times as many micronuclei as controls. When the animals treated with 25 μCi were observed at 12, 24, 36, and 48 hours after injection, 4.75, 5.63, 3.00, and 1.69 fold increases, respectively, were noted in micronuclei. The mitotic index of the bone marrow cells from all treated animals remained below normal throughout the experiment and at the 32nd day was still from 2.4 to 5.1 times lower than the controls. (auth)

51938 SECOND PRIMARY NEOPLASMS IN CHILDREN. Tefft, M.; Vawter, G. F.; Mitus, A. (Children's Cancer Research Foundation, Boston. Children's Hospital Medical Center, Boston. Harvard Medical School, Boston). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 103: 800-22(Aug. 1968).

The records of the Children's Hospital Medical Center were reviewed for the years 1938 to 1963. Case histories are presented of children treated with x radiation for malignancies who developed second tumors, lymphomas, or leukemia. The study revealed that the approximate incidence of double primary tumors in children with malignancy was 0.5%, or 5.0% of all children who received radiation in doses in excess of 1,000 RADS and who had survived free of disease at least two yrs. (auth)

51939 ON THE MODE OF ACTION OF UV LIGHT: EFFECT OF UV-A RAYS ON MAST CELLS IN VIVO. Grof, P.; Kovacs, A. (Univ., Pecs, Hungary). Acta Physiol. Acad. Sci. Hung., 32: 35-44(1967).

Effects of long wavelength uv radiation (350 to 375 nm), so-called uv-A, and unfiltered uv radiation on mast cells were investigated. Both types of radiation caused injury and even destruction of mast cells without affecting other connective tissue elements. The extent of damage depended on the dose used. The threshold dose also depended on the nature of radiation; it was significantly higher when uv-A rays were employed. The full extent of mast cell lesions was seen following secondary reactions after a relatively long period of latency. With small doses, a process of restoration was observed in the latent period, and in some instances, incipient cellular changes showed complete regression. Histamine, stored in mast cells, was liberated when they were destroyed by irradiation. It is suggested that the conditions under which this process occurs are present in human skin, and that uv rays of long wavelength penetrate through the epithelium and reach that layer of the corium which contains mast cells in abundance. Disruption of the mast cells and the consequent liberation of histamine may thus be involved in the development of uv-A erythema, explaining its sudden appearance and rapid disappearance. (BBB)

51940 EFFECTS OF WHOLE-BODY X IRRADIATION ON OVULATED EGGS OF MICE WITH SPECIAL REFERENCE TO THEIR IMMEDIATE FATE AFTER SPERM PENETRATION. Palayoor, Thomas; Batra, B. K. (Tata Memorial Centre, Bombay). Life Sci., 7: 721-30(July 1, 1968).

Female C57Bl mice were given a single 300-R whole-body dose of x rays and mated. The ova shed and fresh corpora lutea in the ovary were enumerated and the tubal ova were classified as penetrated or unpenetrated by sperm. In the case of penetrated eggs the developmental stages were determined on the basis of pronuclear growth. Most (69%) unfertilized ova were adjudged to be morphologically abnormal. Many of the anomalies encountered were comparable with those occurring in untreated golden hamster ova at the time of loss of fertilizability. It appears that the high incidence of unfertilized eggs in the treated group is indicative of aging having been initiated in them by irradiation. None of the unfertilized ova of the control group were morphologically abnormal. Abnormalities were observed in the ova during pronuclear development. There was an increase in the number of eggs in stage III in exposed animals as compared to the corresponding value for controls. A fall in the number of stage IV eggs also was evident. As the sperm was unexposed, these abnormalities could be associated with changes within the irradiated ovum which is the environment of the male gamete during the period preceding syngamy. These changes may be in the cytoplasm itself or indirect cytoplasmic expressions of nuclear alterations. (BBB)

51941 EFFECTS OF PREVIOUS X-IRRADIATION ON THE CELLULAR RESPONSE OF NERVOUS TISSUE TO INJURY. Cavanagh, J. B. (Inst. of Neurology, London). Nature (London), 219: 626-7(Aug. 10, 1968).

The mechanism of the delayed necrosis that follows irradiation of nervous tissue is little understood. Adult nervous tissue is comparatively insensitive to x-irradiation. Studies are described in which changes in cell nuclear population were examined in irradiated rats after sciatic nerve crush. Following doses of 200 and 500 R a reduction of nuclear population was evident 7 days after nerve crush, but recovery to within normal limits was found after 14 days. After 1000 R cell populations were smaller than usual at 7 days and there was only slight recovery by 14 days. After 2000 R there was a negligible increase in cells during the second 7 day period, while the decrease in population during the first 7 days was slightly smaller than after 1000 R. The radiation dose which seriously impaired the subsequent capacity of the resting cells to respond to crushing was 1 to 2 kR, unaffected when the interval between irradiation and crush was 6 months. Studies are also described concerned with mitotic rates, and a quantitative

histological method was developed based on rapid perfusion-fixation for studying mitotic rates around a needle wound in the brain. Rats were head irradiated with 220 kV 15 MA x-rays (Cu and Al filtration) at a dose rate of 90 to 95 R/min, and from 4 to 14 days later a needle wound was made and the animals killed. Mitotic rates after 500 R indicated distribution and numbers of mitoses very similar to unirradiated animals. After 2000 R there was severe suppression of cell increase, particularly at the wound edge, and to a lesser extent at distances away from the wound. After 1000 R there was also a substantial reduction of mitotic rate at the wound edge, but the rate at distances away was substantially increased. Most of the cells in this region showed evidence of fragmented chromosomes, and intermitotic astrocytes with multiple nuclei and other abnormalities were numerous. It is concluded that doses <1000 R given to resting tissue cause sufficiently little damage as to leave the proliferative capacity of both peripheral and central nervous tissue adequate to produce a satisfactory repair process. Above 1000 R the number of cells capable of responding is too small. (UK)

51942 REVIEW OF RESEARCH IN RADIATION BIOLOGY. Sobkowski, Frank J. J. Amer. Dent. Ass., 76: 1381-7(June 1968).

Beneficial and harmful effects of ionizing radiations on animal and human tissue are reviewed (61 references) with emphasis on dental and oral tissues. Young, differentiating but still nondentin-producing odontoblasts appear to be the most radiosensitive cells of the developing tooth germ. In the dental management of the patient with irradiated head and neck cancer, differences of opinion still remain in regard to the preparation of the oral cavity before irradiation, particularly in the optimum time interval between dental extractions and the initiation of radiation therapy. Some laboratory and clinical data indicate that irradiation can be started immediately after dental extractions without risk of delayed root-socket healing or infection and without increasing the hazard of subsequent radio-osteomyelitis. In considering postirradiation sequelae, the importance of a conservative treatment of osteoradionecrosis is stressed. It was reported that dental defects develop only in patients whose salivary glands are included in the field of irradiation, regardless of whether the affected teeth are outside or within the irradiated field. Dental defects did not develop in patients in whom radiation was administered directly to the jaws and teeth but not to the salivary glands. Alteration of salivary physiology was seen by a decrease in the amount of salivary flow. (BBB)

51943 HODGKIN'S DISEASE OF THE JEJUNUM: PERFORATION DURING RADIATION THERAPY. Conger, John D.; Castell, D. O.; Jacoby, W. J. Jr. (Naval Hospital, Great Lakes, Ill.). Arch. Intern. Med., 121: 174-6(Feb. 1968).

In a patient with Hodgkin's disease involving the proximal jejunum, irradiation of the abdomen was associated with perforation of the bowel wall. Because of apparent recurring localized abdominal lymphoma, a course of ^{60}Co therapy to the upper abdomen was initiated. Following the first three doses of radiation, the patient had intermittent nausea and vomiting. Following the third day of radiotherapy after a total dose of 300 R, the patient noted the sudden onset of severe persisting midabdominal pain. It is pointed out that if a radiosensitive mass occupying the intestinal wall undergoes necrosis, the softened area of mural tumor is predisposed to rupture in the period before fibrosis reinstates integrity to the weakened area. It is speculated that this was the mechanism accounting for jejunal perforation in this case. It seemed probable that irradiation itself and not the tumor produced the necrosis of tumor tissue resulting in breakdown of the jejunal wall. Lymphomas are known to be particularly radiosensitive. The total radiation dose of 300 R given in this case would have been adequate to cause regression of the ~1 cm depth of bowel wall involvement with tumor. It is suggested that radiotherapy for abdominal Hodgkin's disease should be used with caution. Thorough evaluation of the gastrointestinal tract with contrast x-ray film studies should precede irradiation to evaluate the presence of intramural tumor that could potentially rupture during radiation therapy. (BBB)

51944 EFFECT OF THE REMOVAL OF THE SUPRARENAL AND EFFECTS OF RADIATION ON THE LEVEL OF CATECHOLAMINE IN THE BRAIN AND MUSCLE. Satsukevich, V. B. Vestsi Akad. Nauk BSSR, Ser. Biyal. Navuk, No. 2, 72-6(1968). (In Russian).

The changes in the content of catecholamine (CA) adrenaline (A), noradrenaline (NA), and their oxidation products (OP) in the brain and muscle of white mice with adrenalectomy and subsequent irradiation in one case with neutrons of intermediate energy at doses ≈13.5 RAD and in the other case with x rays at a dose of 40 R were studied. The animals were irradiated on the fifth day after adrenalectomy. The studies were made on the sixth day after the operation and the day after the irradiation. The content of CA was determined by the trioxyindole method. The results confirmed disturbances in the activity of the sympathetic-adrenal system approaching those caused by the removal of the suprarenal. The level of CA in the brain and muscle was changed. After irradiation of the adrenalectomized animals, these changes were intensified. In the large hemisphere of the brain after adrenalectomy A was detected, the level of NA was close to that of the controls. In the muscle in the absence of A the quantity of NA was significantly increased. The irradiation of adrenalectomized animals with neutrons of intermediate energy somewhat reduced the level of A in the brain and in many cases in the muscle, but x radiation increased these levels. The content of NA was reduced by all forms of irradiation, and OP were found in the muscle of the animals with adrenalectomy and partially after their irradiation, but was absent in the brain. (tr-auth)

51945 INFLUENCE OF INTERNAL IRRADIATION (^{90}Sr AND ^{226}Ra) ON THE CHROMOSOMAL PATTERN OF BONE MARROW CELLS. Baerska, A.; Linetski, Yu. (Lodz Inst. of Occupational Medicine, USSR). Med. Radiol., 13: No. 9, 36-41(Sept. 1968). (In Russian).

A single injection of 30 μCi/kg weight of ^{90}Sr and ^{226}Ra was given to 6-month-old rats which were sacrificed together with appropriate controls 10 days or six months later. The mitoses of dividing cells were blocked in vivo with Colcemide and bone marrow was withdrawn from femor in narcosis. The cell suspension was treated with hypotonic solution and fixed. Altogether 2542 cells were studied in metaphase and slight increase in aneuploidy and in frequency of chromatid aberrations was found in rats burdened with ^{90}Sr and ^{226}Ra both for 10 days and 6 months. The total frequency of stable and unstable chromosomal aberrations amounted to approximately 1% in both short- and long-term exposure to internal irradiation by ^{90}Sr and ^{226}Ra. These aberrations were not observed in control rats. No significant increase in the percentage of bone marrow cells with aberrations was observed when the irradiation was extended from 10 days to six months. The findings of the present study are discussed in view of similar observations on humans and apparent discrepancies are commented upon. (auth)

51946 EXPERIMENTAL STUDY OF THE EFFECTIVENESS OF CYSTAMINE IN THE CASE OF PROLONGED INFLUENCE OF γ RAYS ON RATS. Zelyakova, D. I. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 434-7(1968). (In Russian).

The effectiveness of the radioprotective action of cystamine and that of cystamine with amygdalin in various doses and courses of administration in the case of prolonged external γ irradiation at a dose rate of 16.7 R/hr up to a total dose of 2000 R was studied on an experiment on 140 rats. The indicated dose produces 80–100% death of the animals within a 30 day period. It was established that the administration of the preparations before the beginning of irradiation and repeated administration during irradiation at a daily dose of 150 mg/kg are ineffective. Repeated administration of the preparations in a daily dose of 450 mg/kg has a pronounced toxic effect. The causes of the absence of effectiveness of cystamine under conditions of the irradiation model studied are discussed. (JPRS)

51947 EFFECTS OF SKELETAL IRRADIATIONS. Vaughan, Janet (Churchill Hospital, Oxford). Clin. Orthop. Related Res., No. 56, 283-303(Jan.-Feb. 1968).

The effects of ionizing radiation on bone are reviewed. It must be assumed that there is no threshold dose below which no damage will occur. Reduction of unnecessary radiation exposure to a minimum is essential. Bone cannot be regarded as a uniform tissue from the point of radiation injury. Tissues at carcinogenic risk are the endosteal osteogenic cells, the hematopoietic marrow, and the epithelium closely applied to bone. Clinical observations suggest that myeloid leukemia rather than osteosarcoma is probably the greatest risk in the case of extensive external skeletal irradiation and theoretically may be a hazard in the case of hard β emitters like ^{90}Sr continuously ingested. Dysplasia, resulting in osteoporosis, osteosclerosis, and spontaneous fracture, is not seen at radiation dose levels below those causing carcinogenesis. 140 references. (TSS) (BBB)

51948 MAMMARY NEOPLASIA AFTER IN VITRO X-IRRADIATION OF MAMMARY TISSUE. Shellabarger, C. J.; Schmidt, R. W. (Univ. of Michigan, Ann Arbor). Nature (London), 218: 192-3(April 13, 1968).

Studies are described, using rats, with a view to defining the events which might occur if true in vitro induction of mammary neoplasia takes place on irradiation. Results are interpreted as indicating that initiation of mammary neoplasia by ionizing radiation must be considered as a scopal effect of irradiation, contrasting with thymic lymphoma in the mouse induced by radiation,

a process which clearly is the result of an abscopal effect. (INIS) (UK)

51949 POSTRADIATION CHANGES OF MOUSE AND RAT BONE MARROW CELLS DURING INCUBATION IN VITRO. Kharlamova, L. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 366-71(1968). (In Russian).

The dynamics of the inactivation, death, and lysis of bone marrow cells was studied in nonirradiated and irradiated suspensions incubated at 37° in vitro. The dynamics of inactivation (loss of ability for unlimited multiplication) of hematogenic stem cells in mouse bone marrow suspensions was determined by the method of spleen colonies. Death and lysis of nucleated cells was judged according to the decrease in the number of cells that were not stained by eosin and were not lysed. It was established that the kinetic principles of these processes are the same. Irradiation at a dose of 100 and 190 R led to an acceleration of the inactivation of those stem cells which retained their ability for unlimited division immediately after irradiation. An acceleration of the processes of death and lysis of nucleated cells in vitro was observed only in the case of irradiation at doses of 1000 R and more. (JPRS)

51950 STUDY OF THE DIRECT AND REMOTE EFFECTS OF RADIATION ON BONE MARROW. Vygodskaya, A. L.; Levitman, M. Kh.; Otarova, G. K.; Eidus, L. Kh.; Yarmonenko, S. P. (Inst. of Biological Physics, Pushchino, USSR. Inst. of Experimental and Clinical Oncology, Moscow). Radiobiologiya, 8: 372-80(1968). (In Russian).

Cell destruction and the change in the number of cells of different fractions in rat bone marrow under the influence of direct and remote action of radiation during the first two days after irradiation at a dose of 1000 R with one limb shielded were studied. The existence of remote influences of radiation upon hematogenic tissue, manifested in a substantial cell destruction in the shielded bone marrow, was established. It was shown that the remote effect is caused by a sharp decrease in the number of erythroid cells and a certain decrease in the number of myeloid cells. The number of lymphocytes in the shielded bone marrow does not change significantly. The causes of the drop in the number of cells of different fractions of the shielded and irradiated bone marrow are analyzed. A substantial change in the quantitative and qualitative composition of the bone marrow was detected under the action of nonspecific stress influences, manifested in a redistribution of cells between the bone marrow and blood during the early periods after the influence. (JPRS)

51951 COMPARATIVE STUDY OF THE EFFECTS OF X RAY AND γ RADIATION ON THE SURVIVAL OF RATS UNDER CONDITIONS OF NONUNIFORM INFLUENCES. Avetisov, G. M. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 381-4(1968). (In Russian).

The peculiarities of the biological effects of x and γ radiations were demonstrated in experiments on rats by comparing them under conditions of nonuniform influences. A consideration of the spatial distribution of the tissue doses makes it possible to explain the qualitative and quantitative peculiarities of the course of radiation injury in nonuniform fields. In a comparison of the biological effectiveness of different types of radiations, a strict consideration of the spatial distribution of doses is needed. The RBE of the γ radiation of ^{60}Co in comparison with x rays (Δ = 1,31 mm Cu) according to the criterion $LD_{50/30}$ is equal to 1. (JPRS)

51952 PHYSIOLOGICAL ANALYSIS OF THE ROLE OF THE SYNAPSE IN DISTURBANCES OF THE ACTIVITY OF THE NEUROMUSCULAR APPARATUS AFTER IRRADIATION. Ul'yanitskaya, A. E. (Central Roentgenoradiological Scientific Research Inst., Leningrad. Inst. of Evolutionary Physiology and Biochemistry, Leningrad). Radiobiologiya, 8: 403-7(1968). (In Russian).

In irradiation of a neuromuscular preparation of sartorius muscle and ischiadicus nerve of the frog at a dose of 18 to 20 kRad, a distinct decrease in the work capacity of the muscle begins, detectable according to its contraction in response to stimulation of a motor nerve. At the same time, in the case of direct stimulation the work capacity of the muscle does not differ from the norm. A dose of 18 to 20 kRad does not produce any changes either in the threshold of excitation or in the action potential of the nerve; the action potentials of the muscle in the case of stimulation of a motor nerve become lower than in the control, while in the case of direct stimulation of the muscle they are higher; producing an initial deterioration of the work of the muscle in response to stimulation of a motor nerve, such a dose does not lower the work capacity either of the motor nerve or of the excitable muscle membrane. Consequently, a disruption of the myoneural synaptic transmission is responsible for the primary injurious effect observed immediately after irradiation. (JPRS)

51953 RECOVERY OF THE FETUS AND PLACENTA AFTER RADIATION INFLUENCE. Kogan, V. E. (Inst. of Obstetrics and Gynecology, Moscow. Central Roentgenoradiological Scientific Research Inst., Leningrad). Radiobiologiya, 8: 385-90 (1968). (In Russian).

The change in the state of fetuses and placentas was studied three, seven, and nine days after irradiation of female rats on the tenth day of pregnancy at a dose of 25 R (on the 13th, 17th, and 19th days of pregnancy). It was shown that on the 13th day of pregnancy, the vascularization of the fetal placenta is reduced, and the lifetime of the fetuses under conditions of total oxygen starvation is shortened (69.7 min in the experimental group, compared with 104.9 min in the control). Subsequently, a gradual repair of the vascular disorders in the placenta is observed: by the 17th day of pregnancy, no underdevelopment of the fetal vascular network in the labyrinth portion of the irradiated placentas is detected. Normalization of the response of the fetuses to total oxygen starvation does not set in until the 19th day of pregnancy. Thus, together with high radiation vulnerability of the fetus, a substantial ability for repair after the disturbances of development that arise is detected. (JPRS)

51954 RADIOSENSITIVITY OF DEVELOPING TENCH EMBRYOS (TINCA TINCA L.). Kulikov, I. V.; Timofeeva, N. A.; Shishenkova, L. K. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Radiobiologiya, 8: 391-5(1968). (In Russian).

The effects of aqueous solutions of $^{90}Sr-^{90}Y$ and external irradiation by the γ rays of cobalt-60 upon the embryonic development of the tench were studied under laboratory conditions. Incubation of fertilized tench roe in aqueous solutions of $^{90}Sr-^{90}Y$ with a concentration from 10^{-10} to 10^{-5} curie/liter has no appreciable effect either upon the rate of development of the embryos or upon the quantitative yield of normal and abnormal prelarvae from this roe. The survival rate of the prelarvae for ten days after hatching from the roe incubated in radioactive water does not differ from the control. The prelarvae that hatched from the roe incubated in radioactive solutions proved to be just as resistant to supplementary external γ irradiation (dose 800 R) as the controls. A single external γ irradiation of the roe at the stage of early cleavage increases the yield of anomalous prelarvae at a dose of 50 R; the total yield of prelarvae, however, is unchanged in comparison with the control up to 200 R. A dose of 400 R is absolutely lethal. The prelarvae that hatched from the roe subjected to irradiation at a dose of 200 R subsequently died considerably more rapidly than in the control; doses from 25 to 100 R did not produce any appreciable deviations in their development. (JPRS)

51955 ACQUIRED RADIORESISTANCE FOLLOWING WHOLE BODY IRRADIATION. Taenzer, V.; Krokowski, E. (Free Univ., Berlin, Westend Hospital, Charlottenburg, Ger.). Acta Radiol., Ther., Phys., Biol., 7: 88-96(Apr. 1968).

The investigation has demonstrated that each whole-body irradiation of animals influences the dose/effect relation of a second irradiation. The data indicate that a protective mechanism correlates to the primary dose applied and to the time interval. Only under special circumstances did whole-body irradiation promote protection against a second irradiation. (auth)

51956 RENOGRAPHIC ANALYSES IN RADIATION THERAPY OF CARCINOMA OF THE UTERUS. Brites Patricio, M.; Baptista, A. M. (Instituto Portugues de Oncologia Francisco Gentil, Lisbon. Instituto de Alta Cultura, Lisbon). Acta Radiol., Ther., Phys., Biol., 7: 97-107(Apr. 1968).

In 141 cases of carcinoma of the uterus, 257 isotope examinations of the kidneys with hippuran-^{131}I were performed before and/or after γ radiotherapy. The results revealed that these tests are useful for demonstrating invasion of the parametrium and allow objective evaluation of the therapeutic effect of irradiation in gynecologic cases. (auth)

51957 EVIDENCE FOR EXCISION OF ULTRAVIOLET-INDUCED PYRIMIDINE DIMERS FROM THE DNA OF HUMAN CELLS IN VITRO. Regan, James D.; Trosko, James E.; Carrier, William L. (Oak Ridge National Lab., Tenn.). Biophys. J., 8: 319-25(Mar. 1968). (ORNL-P-3389).

Evidence is presented that human cells in vitro differ markedly from the rodent cells previously studied in that they consistently lose a significant proportion of uv-induced pyrimidine dimers from their DNA. The recovered amnion (RA) cell line derived from human amnion, RAX10 (an RA subline derived from survivors of 1000-R x irradiation), HeLa, and the diploid cell strain WI-38 were used. Within 12 to 24 hr after human cells were irradiated with uv light, ~50% of the uv-induced pyrimidine dimers were lost from the DNA. Pyrimidine dimers were found in the trichloroacetic acid-soluble fraction of uv-irradiated cells at 24 hr. Excess thymidine, caffeine, or hydroxyurea had no effect

on the loss of pyrimidine dimers from the DNA of uv-irradiated cells. It was not possible to achieve greater than 50 to 60% dimer removal. This fraction of dimers was lost within the first 24 hr, with reduced or no further dimer removal thereafter. It is suggested that there are some similarities between the reaction of human cells to uv-irradiation and uv-repair mechanisms in bacteria. Other mammalian cells examined have failed to show any indication of such a phenomenon and human cells seem to be exceptional in this respect. (BBB)

51958 LUMINESCENCE-CYTOCHEMICAL INVESTIGATION OF THE EFFECTS OF γ RAYS AND RADIOTOXINS ON CELLS OF EHRLICH ASCITES CARCINOMA. Kondratenko, V. G.; Khakimov, P. A. (Inst. of Biophysics, Pushchino, USSR). Radiobiologiya, 8: 418-24(1968). (In Russian).

A comparative investigation was made of the effects of γ rays and quinoid radiotoxins on Ehrlich cancer cells. Using a cytofluorimetric method, it was shown that in the development of radiation damage to cellular nuclei, there is an almost complete analogy between the action of ionizing radiation and the action of radiotoxins. It was established that there is a dose and time dependence, and in the case of the action of radiotoxins a concentration dependence as well, in the development of radiation reactions in the DNA-protein complex of the nuclei. It is noted that the effects of radiation anabolites upon cellular nuclei begin to be manifested practically simultaneously with the effects of radiation. It is concluded that in the development of radiation effects, the role of a starter mechanism is played by the action of the ionizing rays, and an important role is played by the effects of radiation anabolites. (JPRS)

51959 WATER AND ELECTROLYTE BALANCE IN ARTERIAL HYPERTENSION FOLLOWING RADON INHALATIONS AT SWIERADOW. Lukasik, S.; Szczeklik, E.; Halawa, B.; Rog-Malinowski, M.; Lukasikowa, W. (Scientific Therapeutic Center, Swieradow, Poland). Pol. Tyg. Lek., 14: 493-6(Apr. 1, 1968). (In Polish).

After 24-day treatment with a single daily Rn inhalation, either with air or with water (radiation doses not stated), data were obtained with respect to sodium, potassium, and creatinine levels in urine, the effects on diuresis, sodium and potassium levels in the blood, and on blood pressure and pulse rate. The study included 11 female and eight male patients (average age 49 yr), with symptomatic arterial hypertension caused by arteriosclerosis in five cases, of renal origin in six cases and idiopathic in eight cases. The controls included eight female and seven male patients (average age 51 yr) free of hypertension. Early morning urine specimens for analysis were collected from the fasting subjects, who subsequently drank 250 ml of boiled water and spent one hr in the Rn inhalation room. Following this, the patients' urine was examined again, then blood pressure and pulse rate were measured and blood samples were taken for biochemical tests. It was found that Rn inhalation had a slightly depressing effect on diuresis, but no effect on potassium and sodium levels in blood serum. A slight decrease of urinary sodium output after Rn inhalations was noted in some patients with hypertension, but these findings were attributed to the incorrect sequence of tests and not to the effects of inhalations as such. Consequently, the data obtained failed to confirm previous reports by Z. Wiktor et al. (BBB)

51960 CONFESSIONS OF A PARANOID RADIOTHERAPIST. Waggener, Ronald. Nebr. State Med. J., 53: 14-16(Jan. 1968).

A pseudo-irradiation reaction is discussed and compared with the true irradiation reaction. The pseudo-irradiation reaction occurs in people who have had one or more doses of irradiation therapy sometime in the past and subsequently become ill. The location of the subsequent illness may be topographically quite different from the original therapy site. The syndrome is a combination of 3 components: (1) previous irradiation of the patient, (2) a subsequent illness of any type, (3) the association of the 2 components into a cause and effect relation in the mind of the observer. This syndrome must be carefully differentiated from the so-called true radiation reactions which clearly exist and are anticipated. Ionizing irradiation reactions include reddening and bronzing of the skin and even moist desquamation or ulceration, diffuse induration of the skin or subcutaneous tissue, irritation of internal structures, and irradiation sickness. Extraction of teeth in persons who have received irradiation therapy in the past may be dangerous. Precautions should be taken by all radiotherapists and dentists whenever patients receive high doses of irradiation to jaws which contain teeth. Subsequent removal of the teeth may allow necrosis or osteomyelitis to develop in the jaw. Antibiotic therapy should be given and the teeth should be carefully removed with alveolectomy and closure of the gingiva. (BBB)

51961 MULTICENTRICALLY SUCCESSIVE FORMATION OF THE SO-CALLED ROENTGEN-LUPUS-SARCOMA. Beisenherz, D.; Hornstein, O. (Univ., Duesseldorf). Z. Haut. Geschlechtskr., 40: 29-33(Jan. 15, 1966). (In German).

A case of recurrent lupus sarcoma following an undetermined dose of x irradiation administered 44 yr previously for fistula formation after surgical removal of tuberculous lymph nodes is described. Histological findings of the excised tumors included very atypical mitotic, polymorphonuclear mesenchymal cells. These were surrounded by multinucleated giant cells. The overall appearance resembled a polymorphocellular giant cell sarcoma. The induction of the lupus sarcoma described was ascribed to the long-term interaction of lupus inflammation with repeated x irradiations. However, sarcomas frequently have been reported to have resulted from lupus vulgaris even without previous irradiation. The increased frequency of carcinomas after irradiation treatment of lupus vulgaris was possibly due to the increased radiation absorption of the epidermis and the tendency of skin to undergo malignant changes because of its high rate of proliferation. (BBB)

51962 LABORATORY REARING AND SUSCEPTIBILITY OF THE CONFUSED FLOUR BETTLE (ADULT) TO GAMMA RADIATION. Hossain, M.; Hossain, M. M.; Rahman, R. (Atomic Energy Centre, Dacca, Pakistan). Food Irradiat., 8: No. 3, 52-7 (Jan.-Mar. 1968).

During a study of the susceptibility of the confused flour beetle, Tribolium confusum (adult), to gamma radiation a mass rearing of the species was maintained and at the same time its life history was studied. The rearing experiment was maintained on a food source of milled flour at 28 ± 2°C and 80 ± 5% R. H. The duration of each of the stages in the life cycle was noted and the dispersion in the growth rate was found to be maximum in the embryonic stage and minimum in the larval stage. Adults of the same age were then exposed to different doses up to 25 kr in mortality experiments. It was found that 100% kill was possible within thirteen days after exposure to between 16 and 25 kr. (auth)

51963 DIETARY CALCIUM AND ZINC EFFECTS IN UNILATERALLY NEUTRON IRRADIATED SWINE. Rosas, Hermel. Knoxville, Tenn., Univ. of Tennessee, 1967. 80p.

Thesis.

Results are reported from studies on the effects of neutron radiation on metabolic changes, postirradiation syndrome, in vitro uptake of ^{65}Zn, average daily gain, and feed conversion in swine fed variable calcium and zinc levels. This investigation should help promote an understanding of the effects of neutron irradiation on animals, thereby facilitating and stimulating further study in this area. (Disser. Abstr.) (TSS)

51964 COMPARATIVE STUDY OF LENTICULAR DAMAGE IN RABBITS DUE TO ACUTE (SINGLE) AND CHRONIC (DIVIDED) FAST-NEUTRON IRRADIATIONS. Hosokawa, Yutaka (Hiroshima Univ.). Nippon Ganka Kiyo, 17: 64-6(Jan. 1966). (In Japanese).

Adult albino rabbits were irradiated with 14.1-MeV neutrons from a T-D reaction neutron generator in the following 5 different total doses administered in 4 fractions: 4×10^9, 8×10^9, 1.6×10^{10}, 3.2×10^{10}, and 4.8×10^{10} n/cm^2, with 1/4 of these doses applied to rabbits at one week intervals. In addition, the following four different total doses were given in two divided doses: 4×10^9, 8×10^9, 1.6×10^{10}, and 3.2×10^{10} n/cm^2, with 1/2 of the dose applied to rabbits at one week intervals. Follow-up of the lens changes was carried out by Zeiss slit-lamp biomicroscopy at one to two week intervals from time of completion of irradiation up to 60 weeks later. Comparison was made of the lenticular changes caused by chronic (divided) irradiation and those caused by acute (single) irradiation that were reported previously. Comparison of the lenticular changes in the group that received fractionated irradiation and changes in the single-dose group failed to demonstrate any marked differences in the development time of opacity or its severity, but the rabbits in the fractionally irradiated group that were exposed to high doses (3.2×10^{10} and 4.8×10^{10} n/cm^2) showed a more rapid progression of opacification of the lenses. (BBB)

51965 CELLULAR EFFECTS OF LASER RADIATION: LIGHT MICROSCOPIC STUDIES ON INJURY OF THE MOUSE LIVER. Faith, Glenn C.; Stein, Marvin N.; Hayes, Jude R.; Stowell, Robert E. (Armed Forces Inst. of Pathology, Washington, D. C.). Arch. Pathol., 86: 262-78(Sept. 1968).

The light-microscopic appearance of the murine liver immediately following laser injury is described. Bursts of ruby laser energy from 23 to 135 J/cm^2 were directed at the exposed livers of anesthetized mice. Immediately, light gray lesions appeared that extended hemispherically into the parenchyma. At high energies, there was cavitation and extrusion of tissue. Microscopi-

cally, the cells were distorted, intercellular spaces widened, and staining properties altered. Nucleoplasmic constituents became aggregated, and cytoplasmic components were often markedly disarranged. Mitochondria in laser-injured cells either stained with greater intensity than the cytoplasmic ground substance, or they lost their identity amid ill-defined small masses of disorganized general cytoplasm. Cytoplasmic clear areas, that likely represented glycogen regions, often became very much enlarged. In laser injury, coagulation is a major pathogenetic mechanism. Evidence of aggregation or increased density of substance was seen in nuclei, mitochondria, and the general cytoplasm. Much, if not all, of this aggregation may be heat denaturation and coagulation of intracellular proteins. In addition to coagulation, there is a second major component of injury by laser: severe intercellular and intracellular disruption. Vaporization of water and the resulting microexpansions are important mechanisms of laser damage. (BBB)

51966 EXPERIMENTAL STUDY ON RADIATION CATARACT. I. RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS AND X RAYS FOR LENTICULAR DAMAGE IN RABBITS. **Hosokawa, Yutaka (Hiroshima Univ.). Nippon Ganka Gakkai Zasshi, 71: 126-34(Feb. 1967). (In Japanese).**

A comparative study was made of the crystalline lenses of rabbits for the damage induced by fast neutrons and by x rays. Twenty-four adult albino rabbits about nine months old were divided into eight groups and exposed to 180-KV x rays at eight different doses ranging from 100 to 800 R. The right eye of the rabbits was exposed to one of these doses of radiation, and the lenticular changes were followed for up to 60 weeks after exposure. The results were compared with the lenticular changes after exposure to fast neutrons (14.1 MeV) from a T-D reaction neutron generator. Lens changes caused by x rays were qualitatively similar to those induced by fast neutrons but quantitatively different. The RBE of 14.1-MeV neutrons compared to 180-KV x rays for lens changes of adult rabbits was 14 in cases where the changes were considered to be permanent and 3.5 where the changes were both permanent and expected to result in impaired vision. (BBB)

51967 MORPHOLOGICAL CHARACTERIZATION OF THE ADRENALS OF WHITE RATS CHRONICALLY ADMINISTERED ^{90}Sr. **Tuzhilkova, T. N.; Shvedov, V. L. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 906-8(1967). (In Russian).**

Various quantities of ^{90}Sr were administered perorally and daily to white rats (0.0005 to 5 μCi per day per animal). The examination of the adrenals began at the start of the experiment and lasted 1.5 years. Increase in the weight of the adrenals was observed after 6 mo in a group receiving 5 μCi and after nine months in a group receiving 0.5 μCi. The increase was due to proliferation of cells of the glomerular zone and increase of the area of all the cortical and cerebral tissue. The sharp increase was accompanied by death of all the animals that received the 5 μCi dose. (JPRS)

51968 ROLE OF NEURAL MECHANISMS IN THE DEVELOPMENT OF INCREASED SENSITIVITY OF THE HEMATOENCEPHALIC BARRIER TO HISTAMINE AND ACETYLCHOLINE WITH SMALL DOSES OF X IRRADIATION. **Gromakovskaya, M. M. (Inst. of Biological Physics, Moscow). Radiobiologiya, 7: 893-9 (1967). (In Russian).**

Mice were examined for 14 to 16 days after receiving a dose of 25 R at 16.6 R/min. High sensitivity of the hematoencephalic barrier to histamine and acetylcholine was found. Suboccipital administration of small doses of histamine or acetylcholine caused retardation of the cardiac rhythm and an increase of reflector excitability of the center of the stimulating nerve. Irradiated mice had a higher mortality than unirradiated. The administration of sodium bromide before irradiation weakened the development of higher sensitivity of the hematoencephalic barrier and reactivity of the center of the stimulating nerve and reduced the mortality of irradiated animals upon administration of histamine and acetylcholine. (JPRS)

51969 INCIDENCE OF LEUKEMIA FOLLOWING TREATMENT OF HYPERTHYROIDISM. **Saenger, Eugene L.; Thoma, George E.; Tompkins, Edythalena A. J. Amer. Med. Ass., 205: 855-62(Sept. 16, 1968).**

The incidence of leukemia in hyperthyroid patients treated by ^{131}I was compared to the incidence in patients treated differently. Of 36,000 patients from 26 medical centers, approximately 22,000 were treated with ^{131}I and about 14,000 were treated surgically or solely with antithyroid drugs. More than 96% of patients were followed up. Forty-four cases of leukemia occurred after, and 16 before, treatment. The incidence of leukemia in patients treated with ^{131}I for hyperthyroidism and the incidence in those treated surgically do not differ. Patients both undergoing surgery and receiving ^{131}I have a higher incidence of leukemia than any other treatment group. The observed mortality from leukemia for hyperthyroid patients is 50% higher than that of the U.S. population. (auth)

51970 RUPTURE OF THE AORTA DUE TO RADIATION INJURY. **Poon, Tung Pui; Kanshepolsky, Jose; Tchertkoff, Victor (New York Medical Coll.). J. Amer. Med. Ass., 205: 875-80(Sept. 16, 1968).**

Necrotizing aortitis with rupture is a rare complication of radiation of mediastinal structure. To our knowledge, this is the first electron microscopic study of radiation changes of the aorta. Collagen fibers were preserved, but there was slit-like irregular fragmentation of elastic fibers. The patient had an empyema. It is postulated that infection combined with radiation necrosis may have triggered the rupture. (auth)

51971 EFFECT OF X-IRRADIATION ON POSTEMBRYONIC DEVELOPMENT OF THE RED COTTON BUG, DYSDERCUS KOENIGII. **Harwalkar, M. R.; Nair, K. K. (Bhabha Atomic Research Centre, Bombay). Ann. Entomol. Soc. Amer., 61: 1107-11(Sept. 1968).**

Studies to determine the radiosensitivity of the five nymphal instars of Dysdercus koenigii (F.) showed that the ability of the x-irradiated nymphs to molt and metamorphose into adults depended on both the dose administered and the instar of the nymph irradiated. The 1st- and 2nd-instar nymphs were sensitive to doses as low as 2 kiloroentgens, whereas 5th-instar nymphs could withstand doses up to 12 kiloroentgens. Irradiation of an instar during its late phase did not affect its next molt, but radiation damage manifested itself in subsequent molts. Irradiation of an instar during its early phase affected its next molt. Adult emergence decreased with increase in dose, and at higher doses most of the emerged adults had severe wing deformities. (auth)

51972 DESTRUCTIVE ENERGY OF SUNLIGHT. **Knox, John M.; Freeman, Robert G.; Ogura, Ryohei (Baylor Univ., Houston, Tex.). Dermatol. Int., 4: 205-12(Oct.-Dec. 1965).**

Some of the biochemical alterations that are known to occur following uv irradiation were presented and discussed. Most effects of sunlight on the skin were harmful rather than beneficial. Degenerative changes in skin were caused by cumulative injury from uv rays of the sun. The extent of damage apparently was determined by total amount of exposure and the degree of natural and artificial protection. Light sensitivity was manifested in polymorphic light eruptions, porphyria, pellagra, lupus erythematosus, xeroderma pigmentosum, hydroa aestivale, and colloid milium. Patients received partial or complete protection from damaging uv rays by using chemical or physical sunscreens. Selected patients also benefited from a local steroid or an orally administered antimalarial agent. (BBB)

51973 POSTRADIATION PERICARDITIS WITH CHRONIC PERICARDIAL EFFUSION. **Masland, David S.; Rotz, C. T. Jr.; Harris, John H. Jr. (Carlisle Hospital, Pa.). Ann. Intern. Med., 69: 97-102(July 1968).**

Despite sporadic reports of postirradiation myocardial-pericardial damage, it is generally accepted that the myocardium and pericardium are resistant to permanent or significant damage from doses of irradiation delivered during the usual ortho- or supervoltage radiotherapy techniques that included the mediastinal structures. Three cases of postirradiation chronic pericarditis with effusion are reported, and the importance of this complication occurring after multiple courses of mediastinal irradiation is emphasized. The three patients (10%), whose histories are presented, received multiple courses of radiation therapy to the mediastinum because of recurrent mediastinal masses of Hodgkin's disease (two patients) or for bilateral breast carcinoma (1). Each developed pericardial effusion that was unresponsive to therapy. Two required pericardiectomy, and the third died of Hodgkin's disease one month later. The total doses calculated at the anterior surface of the heart were 9600, 6700, and 8050 rad. The pericardial effusions were detected between three and eight months after completion of radiation therapy. In each of these patients the pericardial effusion was clear and amber, and the pericardium was thickened and fibrotic. An increase in collagenous elements and capillary and arteriolar changes were thought to be consistent with radiation effect. It is concluded that permanent pericardial damage may result from repeated courses of irradiation to the mediastinum when the total accumulative dose, as calculated at the anterior surface of the heart, is of the order of 5000 rad or greater. The risk of producing irreversible fibrosis of the pericardium with resultant pericardial effusion must, therefore, be considered in the decision to reirradiate the mediastinum after a previous course of radiotherapy. (BBB)

51974 ROLE OF RADIOTHERAPY IN THE TREATMENT OF INCIPIENT ANAL CANCER (BASED ON 58 OBSERVATIONS). **Papillon, J.; Montbarbon, J. F.; Chassard, J.-L.; Dutou, L.;**

Croisille, M.; Alziary de Roquefort, G. Arch. Fr. Mal. App. Dig., 57: 57-73(Jan.-Feb. 1968). (In French).

Development of radionecrosis, functional impairment, and adenopathy in the course of radiotherapy of early anal cancer was reported. Possibilities of curing the cancer and conserving sphincter function by means of irradiation as opposed to surgery were considered in an analysis of 58 cases of small anal cancers. Between 1949 and 1958 contact radiotherapy at 50 kV was used in 17 cases; between 1959 and 1966 palisade or cylindrical Ra implantation was used in 41 cases. Details were given of the technical procedures used to maximally protect healthy tissue. The principle behind the use of Ra implants was protection of the anal sphincter muscle function. Failures with this method included development of necrosis requiring amputation of the terminal portion of the bowel and colostomy, as well as relapses and local tumor growth. Contact therapy resulted in six failures out of 17 as compared with eight out of 41 cases treated with Ra. The painful reactions observed were generally benign, temporary, and medically curable without colostomy or other surgery. Cicatrization usually was followed by complete and painless restoration of sphincter function. Ten patients showed local adenopathy although the anal tumor was sterilized. Three patients died, the other seven appeared cured. Over-all survival for five years was 67% or 37 cases. It was concluded that Ra implantation under the conditions used was the best method for treating incipient anal cancer. (BBB)

51975 OBSERVATIONS ON A SERIES OF 87 CASES OF RADIOACTIVE HYPOPHYSECTOMY. Gros, Cl.; Vlahovitch, B.; Frerebeau, Ph. (Clinque Neuro-Chirurgicale, Montpellier, France). Neuro-Chir., 12: 663-70(Nov. 1966). (In French).

Radiation injuries and complications are discussed in a survey of 87 cases of radioisotope-induced hypophysectomy in cancer patients. In 86 cases ^{90}Y was used and in one case ^{198}Au. Seeds of ^{90}Y were introduced by means of a trocar through the nose to the sella turcica. The average number of seeds used was 6, each providing 3 mCi. The most serious complication was the appearance of cerebrospinal fistulas and rhinorrhea at the point where the radioisotope was inserted. In 9 cases damage was permanent, resulting in meningitis, relapses, and 5 deaths. In 14 other cases the fistulas were only temporary and were successfully treated by surgical methods. Precautions against this form of injury included more careful introduction of the radioisotope via the nasal route. Diabetes insipidus was another radioinduced complication, occurring in 47% of cases (33 out of 70) and was affected by the positioning of the ^{90}Y grains. It was permanent in only 3 cases. Two conclusions were drawn: the use of ^{90}Y for destroying the pituitary gland was effective and the problem of fistulas was primarily temporary since they could be repaired by surgery. (BBB)

51976 EFFECT OF LASER RADIATION ON LIVING CELLS STAINED WITH ACRIDINE ORANGE. Calzavara, F.; Flores d'Arcais, F.; Frasson, F. (Univ., Padua). Minerva Radiol., 13: 223-9(Apr. 1968). (In Italian).

The physical principles upon which the emission of laser energy is based are briefly described, and the distinctive features of this type of radiating energy are illustrated. The results of experiments done by focalizing laser energy under a microscope onto living rat liver cells before and after staining with acridine orange are given. The transparent cells were sensitized to laser. The possible use of this fluorochrome is suggested as a vehicle in neoplastic cells in order to investigate the effect of laser. (auth)

51977 POSTRADIATED OVARIES AND UTERI. Khan, P. K. (IPMER, Calcutta). J. Obstet. Gynaecol. India, 16: 164-6(1966).

A study of 14 cases was presented in which deep x-ray sterilization was done 6 to 12 yr ago for reasons such as dysfunctional uterine bleeding, fibroids, and endometriosis. Multiple corpora albicantes and atrophic changes in the ovaries were the commonest findings. Stromal hyperplasia of the cortex was present in two cases where the cells were grouped in bundles and whorls. No lipid-laden cells were observed in these clusters. No oocytes, primordial, or mature Graafian follicles were observed. Hyalinization of the stroma was a significant finding in post-irradiated ovaries. (Indian Sci. Abstr.)

51978 DANGER OF RADIATION IN STOMATOLOGY. Ducka-Karska, Krystyna (Orthodontic Clinic, Warsaw). Czas. Stomatol., 19: 455-7(Apr. 1966). (In Polish).

Hazards of x rays, used to treat oral cancer, to the radiologist, other physicians, and the patient are discussed. Exposed radiologists and stomatologists may develop such pathologic changes as dryness of skin and lesions on the palms, crenated fingernails, inflammation of malar terminal vessels, changes in the retina and crystalline lens; irradiation may also affect the thyroid gland, salivary glands, lymph nodes of the neck, and rarely cause leukemia and aplastic anemia. To reduce radiation hazards, accurately calculated radiation doses should be based not only on the physical conditions of exposure, but also the age of patient, his state of general health, and a total dose of previously received radiation. Radioprotective measures should stipulate rules for protection of personnel directly exposed as operators of x-ray apparatus, also personnel present in the same building and exposed indirectly. Since x rays can penetrate walls up to 15 cm thick, the floor and walls of x-ray rooms should be shielded with barytes bricks, and the room should be thoroughly ventilated, with total air volume changed 6 times per hr. The x-ray technician should not receive more than 0.3 R as a total-body dose per week. He should be protected by a leaded glass or leaded rubber curtain and have frequent, periodic medical examinations. (BBB)

51979 EFFECT OF WEAK γ RAYS ON THE GROWTH AND BLOOD PICTURE OF CHICKENS. Menke, K. H.; Steffens, W. (Univ., Bonn. Kernforschungsanlage, Juelich, Ger.). Landwirt, Forsch., 20: 133-8(1966). (In German). (JUL-386-LW).

The effect of 83-day irradiation of chickens on the growth and blood system was studied. The results showed that 17 R in 12 weeks decreased the growth approximately 7%. Two R had a low weekly significant growth inhibiting effect whereas the animals treated with 5 R showed no significant depression. The analysis of the blood picture produced a leukocyte count decrease with increasing radiation dose and a simultaneous decrease in the erythrocyte count from 2.97 to 2.65 million ml. The very low growth modification in the middle group could be explained as a result of two opposing stimulating and inhibiting effects of radioactive beams in the dose range. The research yielded no indication of a growth-stimulating effect of radioactive beams in chickens. (tr-auth)

51980 HODGKIN'S-LIKE RETICULUM CELL SARCOMA IN SJL/J MOUSE: AN ANIMAL MODEL OF LYMPHOMA TO SOLVE CLINICAL PROBLEMS. Rubin, Philip (Univ. of Rochester, N. Y.). Radiol. Clin. N. Amer., 6: 25-40(Apr. 1968).

The use of a Hodgkin's-disease-like mouse model to explore the value of prophylactic irradiation in man is reported. Hodgkin's-like or reticulum cell lymphoma was produced by injection of a small bolus of cells into a specific anatomic site in an attempt to develop a unicentric origin of this disease. Whether local or extended field irradiation could alter the pattern of progression of disease and possibly lead to control or cure was explored. The animals were injected in the right axillary region with 15,000 to 20,000 cells. In three weeks, 80% of mice developed axillary nodes, 0.5 to 1.0 cm in size. The right hemothorax, neck, and axilla were treated to 200 R x for five weeks or 1000 R in one week by 280-kV x radiation. In another group extended field irradiation was tried. The entire thorax, both sides of the neck and both axillae were irradiated as above. After one week, another course of irradiation was delivered to the abdomen. There was little difference in survival in the locally irradiated animals of the control group. Dissemination occurred rapidly, with splenic involvement. The main difference between the mice with local irradiation and the control group was the regression of local disease. At two months there was a 71% survival for the extended field irradiation vs 20% for the control and locally irradiated mice. Thus, extended field irradiation is more effective in controlling the disease than local fields despite apparent localization of disease nodes. (BBB)

51981 EFFECT OF FRACTIONATED GAMMA-RAY IRRADIATION ON THE PROLIFERATIVE ACTIVITY OF BONE MARROW CELLS OF FASTED RATS. Ninkov, V.; Dragic, M.; Karanovic, J. Bull. Boris Kidric Inst. of Nucl. Sci., Biol., 18: No. 1, 1-6(Oct. 1967).

The effect of fractionated γ irradiation (3 x 200 R) on hematopoiesis of fasted rats was studied. The results showed that four days of starvation led to depletion of erythroid bone marrow cells, whereas myeloid cells did not show disturbed mitotic activity. Realimentation soon led to the regeneration of erythroid cells and increased proliferation of myeloid cells. After fractionated irradiation the recovery of erythroid cells was relatively intense and quick. The stimulative effect of realimentation on mitosis was not fully effective during regeneration indicating that irradiation in the dosages given decreased the reproductive ability of these cells. (auth)

51982 EFFECT OF MICROWAVES AT X-BAND ON GUINEA-PIG SKIN IN TISSUE CULTURE. I. MICROWAVE APPARATUS FOR EXPOSING TISSUE AND THE EFFECT OF THE RADIATION ON SKIN RESPIRATION. Lawrence, J. C. (Birmingham Accident Hospital, Eng.). Brit. J. Ind. Med., 25: 223-8(July 1968).

An apparatus was designed that enabled small pieces of skin to be exposed to a uniform field of microwaves at the X-band (8730 MHz). It was used to investigate the effect of these micro-

waves at selected energy levels on the metabolism of skin. Skin cultured in vitro exhibited a graded response to microwave energy, and a dose-response curve was constructed from this data. The ED_{50} (effective dose in 50% of the samples) of this curve was 4740 mW/cm^2, applied for 1 sec. Microscopic examination of 3-day cultures of skin showed that histological abnormalities occurred if the specimens were exposed to intensities of microwaves causing more than 30% respiratory inhibition. The energy level at the ED_{30} was 2880 mW/cm^2, applied for 1 sec. The results indicated that tissue damage caused by irradiation with microwaves was due to the energy absorbed by the specimen being converted to heat. (BBB)

51983 ROLE OF ORGANIC PEROXIDES IN THE INITIAL STAGE OF RADIOINDUCED INJURY IN ANIMALS. Popov, A. S. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 825-30(1967). (In Russian).

A clone of Paramecium caudatum was put into irradiated solutions of pyrimidine bases (20 cells/0.1 ml) for 60 to 80 minutes, then transferred to fresh water and incubated for 24 hrs at 22°. Their survival and rate of division were then determined. The substances were then dissolved in a phosphate buffer at pH 7.0 to 7.2 and irradiated, and the pyrimidine hydroperoxides forming during radiolysis were determined. It was found that the pyrimidine peroxides did not increase the radioinduced injury of the infusoria, and it was concluded that organic peroxides did not play a large role in initial radiation injury, although if pyrimidine hydroperoxides formed directly on the DNA they could cause lethal mutations. (JPRS)

51984 EFFECT OF FRACTIONATED IRRADIATION ON THE REPRODUCTIVE CAPACITY OF THE BONE MARROW CELLS IN FASTED RATS. PRELIMINARY REPORT. Ninkov, V.; Dragic, M.; Karanovic, J.; Hajdukovic, S. Bull. Boris Kidric Inst. Nucl. Sci., Biol., 18: No. 2, 7-11(Oct. 1967).

The combined effect of acute starvation and fractionated γ irradiation (3 × 100 R) on the proliferative activity of bone marrow cells in rats was investigated. Results showed that after four days of acute starvation the formation of erythroid marrow cells almost completely ceased, while in the case of myeloid cells it was not so. Fractionated irradiation in fasted rats reduced the regeneration rate of erythroid cells and their maximum proliferation. (auth)

51985 INFLUENCE OF LASER BEAMS ON THE GROWTH OF HAIR IN MICE. Mester, Endre; Szende, Bela; Gartnerne, Tota Jolan. Kiserl. Orvostud., 19: 628-31(1967). (In Hungarian).

Low-energy laser radiation first increased the growth of hair but after three times the amount of the initial dose was applied, hair growth was retarded. When a single large dose was applied, hair growth was arrested. In black mice the above phenomenon occurred after a relatively small amount was administered and in white mice only after a relatively large dose. It was believed that low-energy laser radiation had a beneficial effect on cell division, while high-energy laser radiation caused infection and damaged the hair-forming cells. (JPRS)

51986 EFFECTS OF IONIZING RADIATION ON THE DEVELOPING DUODENAL MUCOSA OF THE CHICK. Verzosa, Vincente Sipin Jr. Evanston, Ill., Northwestern Univ., 1967. 149p.

Thesis.

The developing duodenal mucosa was studied in normal and 700 R x-irradiated chick embryos ranging in age from 4 days to 21 days (hatching) of incubation including 1 and 2 day old hatched specimens. Four normal developmental periods were established namely, early proliferative, late proliferative, maturing, and mature periods. Specimen ages belonging to these periods were: 4 to 11, 12 to 15, 16 to 19, and 20 and 21 days of incubation respectively. (Diss. Abstr.) (TSS)

51987 MECHANISM OF THE THERAPEUTIC ACTION OF DELAYED RESTORATION IN IRRADIATED MICE. Duplan, J. F.; Monnot, P. (Institut du Radium, Paris). Nouv. Rev. Franc. Hematol., 7: 167-76(Mar.-Apr. 1967). (In French).

After injection of isogenic bone marrow cells into mice irradiated seven days earlier, restoration took place in two phases: an immediate and transitory therapeutic effect that reduced the early mortality and late regeneration of the hematopoietic system as a result of renewal of hematopoietic organs by injected cells. This regeneration allowed survival of the mice. For a better understanding of the mechanism of the immediate therapeutic effect, a hematologic and histologic study was made on two groups of mice irradiated at a dose of 800 R (LD_{98}) and restored after seven days, some with 4×10^7 cells; others were restored with two injections of 2×10^7 femoral marrow cells. In the second group successive injections were made on the seventh and eighth days. Mortality was 63% in the first group and 40% in the second. It became evident that the suspension of bone marrow that was rich in platelets prevented the anemic manifestations of thrombocytopenic purpura and prevented the fall of red cells below a number incompatible with survival of the mice. The therapeutic method had only limited effectiveness on the control of the hemorrhagic syndrome and seemed to have no influence on the gastrointestinal disorder. However, delayed restoration permitted the survival of the animals when a simple transfusion of platelets was ineffective. (BBB)

51988 CASE OF OCCUPATIONAL ACUTE ACCIDENTAL RADIATION INJURY. Kitabatake, Takashi; Kobayashi, Shinichi; Sakai, Kunio; Kurokawa, Shigeki (Niigata Univ., Japan). Acta Med. Biol. (Niigata), 15: 227-32(Mar. 1968).

Acute accidental radiation injury to an industrial x-ray fluorescent spectrometric worker is reported. The apparatus was designed so that under usual operation x rays were automatically intercepted whenever the lid of the sample chamber was opened for any reason. Therefore, a worker was not usually exposed to x rays even if the sample change was made with the x ray energizing circuit closed. During fluorescent spectrometric work the subject recognized an abnormal wave in the oscillograph and opened the lid to examine the sample. No sample was present in the sample chamber, and he then inserted his left hand into the sample chamber. He received 2000 to 3000 R of soft x rays (45 kVp) over the fingers. Erythema appeared about 14 hr after exposure, edema the first to second day, and blisters the fourth day. On the 14th day a severe local skin reaction, consisting of third degree dermatitis, was seen. On the 21st day a tendency toward recovery was noted. From the 30th to the 45th day after exposure, the injury healed with moderate scarring. In the entire clinical course, the patient was in good general condition without any positive lab findings. (BBB)

51989 DELAYED MORTALITY IN SUBLETHALLY IRRADIATED MICE TREATED WITH ALLOGENEIC LYMPHOID AND MYELOID CELLS. Boranic, Milivoj (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk, Netherlands). J. Nat. Cancer Inst., 41: 439-50(Aug. 1968).

RF mice were irradiated with a high sublethal dose (530 rads) of x rays and treated with C57BL spleen cells, bone marrow, or both. Administration of bone marrow cells produced transient chimerism and, occasionally, midlethal dose effect. Treatment with mixed cell inocula containing $5\text{-}10 \times 10^6$ spleen cells and $30\text{-}40 \times 10^6$ bone marrow cells resulted in development of a chromic wasting syndrome terminating in death 1-2 months after treatment. In these mice, chimerism was more frequently present than in mice receiving bone marrow only. It is concluded that allogeneic immunocompetent cells may promote the take of a simultaneously administered bone marrow graft by reinforcing irradiation damage to the recipient's hematopoietic tissue. This may result in a chronic secondary disease. (auth)

51990 EFFECTS OF REPEATED LOW-DOSE X-IRRADIATION ON DISCRIMINATION AND RADIOSENSITIVITY. Johnson, James Michael. Tallahassee, Fla., Florida State Univ., 1967. 110p.

Thesis.

Twelve male albino rats were trained on a two bar discrimination task. They were required to emit a specified minimum number of responses to the left bar of a Skinner box and then one additional response to the right bar for each reinforcement obtained. For example, on a requirement of twelve and one, a minimum of twelve responses to the left bar was necessary, followed by one to the right bar. Premature switches to the right bar were not reinforced, but made it necessary that the animal begin the requirement again. There were no extroceptive cues to facilitate the discrimination. Records were taken of the response rates and sequences of responses to the left bar for each subject. Following this initial training, the Ss were divided into four groups of three animals each. Each group was then exposed to 0R (control), 7R (low), 14R (medium) or 21R (high) each day at the rate of 7R per minute. Employing the same discrimination task, behavioral assessments of the radiation effects were calculated for the days of stable responding on two different ratio requirements. In addition to response rate, attention was also focused on the efficiency of the Ss in obtaining reinforcement. The discrimination efficiency of a S was determined by calculating the average number of responses per reinforcement, the average percentage of reinforcement, and average percentage of efficient reinforcements. The latter two measures were dependent on the pattern of response sequences to the left bar. At the ratio requirement of twenty-four and one, there were no differences among the groups in response rate or on any of the measures of discrimination. This was after 41 daily exposures giving cumulative dose totals of 0R, 287R, 574R, and 861R for the control, low, medium, and high groups respectively. However, the stability days on ratio forty-eight and one showed marked differences

among the groups. The three experimental groups with cumulative exposure totals of 1618R, 3341R, and 4869R all displayed a response decrement compared to the increase in response rate demonstrated by the control group. The measures of discrimination also differentiated among the groups. The control group had a higher percentage of reinforcement but a lower percentage of efficient reinforcements. The high dose group was significantly inferior to the other groups on two of the efficiency measures; average number of responses per reinforcement, and average percentage of reinforcement. In order to allow an assessment of the effects of these various histories of radiation exposure, a lethal dose of 750R was then administered to all the Ss. They showed response decrements in relation to the previous cumulative doses, that is, the greater the cumulative dose, the greater the response decrement. Each group also displayed an increasing amount of decline with each succeeding day after the lethal dose. Complete response suppression and the demise of the Ss terminated the experiment. Some of the conclusions were that an amount of radiation is less effective when delivered in fractionated doses than a dose of equal magnitude delivered in a single exposure. Also, a history of low-dose exposures sensitizes an animal to later high dose exposure. It makes him less able to sustain the radiation injury. Some discussion was given to the clinical implications of the observed decrements in response rates and in performance on the discrimination task. (Diss. Abstr.)

51991 INFLUENCE OF ADRENOTROPIC SUBSTANCES ON THE NEUROSECRETORY FUNCTION OF HYPOTHALAMIC NUCLEI. Andrianova, L. A. (Inst. of Medical-Biological Problems, Moscow). Med. Radiol., 13: No. 4, 28-32(1968). (In Russian).

Neurosecretory function of hypothalamic nuclei after the action of adrenotropic substances was studied in intact and irradiated rats. The neurosecretory nuclei of irradiated animals are characterized by an accumulation of secreta, some cells completely filled with neurosecretory granules. Preliminary administration of adrenaline did not cause any essential changes in the reaction of neurosecretory nuclei of the hypothalamus to the effect of ionizing radiation. After preliminary administration of aminazine subsequent irradiation did not cause a characteristic accumulation of secreta. (auth)

51992 MORPHOLOGICAL CHANGES IN NASAL MUCOSA OF ANIMALS UNDER THE EFFECTS OF VARIOUS AGENTS. Ostapkovich, V. I.; Cherkasskii, L. A. (Nose, Throat, and Ear Clinic, Moscow. Inst. of Hygiene and Occupational Diseases, Moscow). Vestn. Otorino-Laringol., 27: 50-5(Jan.-Feb. 1965). (In Russian).

Rats weighing 120 to 200 g received a single intraperitoneal injection of 1.5 to 9 μCi of ^{90}Sr per g body wt. Their average lifetime was 7 to 135 days, and daily observations were made of various stages of radiation sickness progressing toward death. The severity of histopathologic changes in nasal mucosa varied according to a dose received and the elapsed postirradiation time. Microscopic examinations revealed the presence of congestion, cellular infiltration of mucosa, exudation, proliferation and dilatation of gland ducts, various terminal epithelium and epitheliogiandular changes, and necrotic processes in the mucosa of the nasal cavity. A similar study was conducted in 43 rats with smaller doses of ^{90}Sr, 0.25, 0.5, and 0.75 μCi/g. The lifetime of rats varied from 24 to 480 days (21 rats survived longer than 200 days). Causes of death included osteosarcoma, leukemia, noma of the snout, and peritonitis. Exudation from the nasal cavity appeared 5 months after the exposure. Other experiments included 29 rats (wt 150 to 230 g) subjected to external irradiation with a proton beam, they received from 870- to 1050-rad whole-body irradiation within 3 to 15 min. Many rats died shortly afterwards and others were killed 3 to 20 days later. Microscopic studies of the nasal mucosa revealed in most animals a nonuniform circulatory bed due to vasodilatation in one area and stasis condition in another, also thrombotic areas and many hemorrhages, as well as necrotic lesions of the nasal mucosa and snout. (BBB)

51993 RELATIONSHIP BETWEEN THE FLUORINE AND CALCIUM CONTENTS IN THE DIET AND THE RESISTANCE OF ANIMALS TO THE INFLUENCE OF γ IRRADIATION. Knizhnikov, V. A.; Grozovskaya, V. A. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 429-33(1968). (In Russian).

The significance of the level of intake of calcium and the trace element fluorine with the diet for the radioresistance of animals to single and fractionated whole-body γ irradiation was studied in chronic experiments on 312 noninbred white rats. It was established that a diet enriched in calcium and fluorine substantially increases the radioresistance of the animals. (JPRS)

51994 THE INFLUENCE OF ELECTROMAGNETIC FLUCTUATIONS OF THE RADIOFREQUENCY SPECTRUM ON THE NEUROSECRETION OF THE HYPOTHALAMUS AND ENDOCRINE GLANDS. Zubkova-Mikhailova, E. I.; Alekseev, Yu. N. (Voronezh Medical Inst., USSR). Byull. Eksp. Biol. Med., 65: 115-18 (Jan. 1968). (In Russian).

Albino rats were subjected to the energy of an electromagnetic field. Changes in the intensity of neurosecretion in the hypothalamus and functional shifts in the endocrine glands, thyroid and adrenal glands, were measured. These disturbances varied depending on the frequency of electromagnetic fluctuations of the field. During irradiation with radiowaves with a frequency of 27 megacycles per second there was an intensified formation of neurosecreta in hypothalamic nuclei and its displacement into the posterior lobe of the hypophysis; the function of the thyroid and adrenal glands also increased. Radiowaves with a frequency of 9.5, megacycles, 9.5 kilocycles, and 27 kilocycles per second in similar conditions caused different changes in the neurosecretion, manifested by stimulation of neurosecreta displacement or by manifestations of its stasis. An intensive outflow of secreta into the neurohypophysis was attended by an increased functional activity of the thyroid and adrenal glands. (auth)

51995 A QUANTITATIVE MEASUREMENT OF CELL DAMAGE BY MEANS OF ^{51}Cr-BINDING. Scaife, J. F.; Brohee, H. (EURATOM-CCR, Ispra, Italy). Exp. Cell. Res., 46: 612-15 (June 1967).

Rat thymocytes and human kidney cells were placed in media containing ^{51}Cr sodium chromate. Suspensions of thymocytes were prepared from rat thymus glands and kept in media at 0° and 37°C. Thymocytes were damaged by homogenization, low temperatures, and x radiation; uptake of ^{51}Cr was nearly 500% greater in damaged cells than in normal cells. One portion of the kidney cell culture was treated with trypsin for 7 min and another portion was treated for 21 min. Binding of ^{51}Cr by kidney cells was greatly increased by extending the trypsinization time. This indicated enzymatic damage to the cell membrane. (H.L.W.)

51996 THE PATTERN OF VASCULAR LEAKAGE INDUCED BY MONOCHROMATIC UV IRRADIATION IN RATS, GUINEA PIGS, AND HAIRLESS MICE. Cotran, Ramzi S.; Pathak, Madhukar A. (Harvard Medical School, Boston. Massachusetts General Hospital, Boston. Boston City Hospital). J. Invest. Dermatol., 51: 155-64(Sept. 1968).

Skin sites in guinea pigs, rats, and hairless mice were exposed to ultraviolet radiation at 3000 Å for 2½ to 20 sec. The time sequence of increased vascular permeability was studied by the estimation of local exudation of intravenously injected trypan blue, and the sites of vascular injury were localized by the deposition of colloidal carbon. A delayed prolonged increase in vascular permeability was regularly induced in the 3 animal species. It started 4 to 6 hours after ultraviolet injury and reached a peak between 12 and 24 hours, the maximal effect being somewhat earlier in guinea pigs than in rats and hairless mice. An immediate, modest, transient reaction was obtained in rats and guinea pigs but not in hairless mice. The site of vascular injury in the delayed phase was localized to the superficial capillary network and the dermal networks of venules and capillaries. These findings have been discussed in relation to the mechanism of vascular damage in ultraviolet injury. (auth)

51997 INCIDENCE OF HYPOTHYROIDISM IN PATIENTS TREATED WITH RADIOIODINE-131. Staffieri, J. J.; Lacerda, L.; Cardonnet, L. J.; Tommasino, P. O. (Fundacion para el Fomento de Estudios Endocrinologicos y Metabolicos, Rosario, Argentina). Medicina (Buenos Aires), 26: 85-90(Mar.-Apr. 1966). (In Spanish).

The incidence of iatrogenic hypothyroidism as a complication of the treatment of hyperthyroidism with ^{131}I was analyzed in 75 patients, some of whom were treated more than six yr earlier. Hypothyroidism and myxedema are defined for the purposes of classification. The material was divided into three groups according to the time following ^{131}I treatment: less than three yr; between three and six yr; and more than six yr. Total incidence of hypothyroidism was 16%, with a progressive increase of 6.6, 15.3, and 31.5% in the three successive groups. The frequency of myxedema was much less (total 6.6%) with a progressive increase in the three groups of 0%, 2.6%, and 4%. It was noted that only the myxedematous patients had sufficient symptomatology to motivate their consultation of a physician. The factors that condition development of radioinduced hypothyroidism are discussed. It is pointed out that there are variations in individual susceptibility. The possibility of overdose can be diminished by special precautions in patients under 45 yr with small and diffuse goiters, without a palpably hypertrophied gland, or with postsurgical recurrence. The necessity for close follow-up for a prolonged period in patients treated with ^{131}I is pointed out, in addition to the necessity of informing these patients of the

true incidence of this undesirable side-effect so that early detection and treatment of this form of iatrogenic hypothyroidism can be carried out. (BBB)

51998 CONTRIBUTION OF BILE TO RADIATION-INDUCED SODIUM LOSS VIA THE RAT SMALL INTESTINE. **Forkey, Delores J.; Jackson, Kenneth L.; Christensen, Gerald M. (Univ. of Washington, Seattle). Int. J. Radiat. Biol., 14: 49-57(1968).**

Small intestine DNA and net small intestine transport of sodium were measured in bile-duct-ligated and sham-operated rats. Analyses of DNA indicated that bile played no measurable role in the extent or rate of loss, or rate of repair of the mucosa after x-irradiation. Net transport of sodium was measured in vivo after 1500 R x-irradiation in animals with and without bile-duct ligation. Three days after irradiation, leakage of sodium across the intestine from blood to lumen occurred in the absence of bile and bile acids had no significant effect on the magnitude of the leakage. It is concluded that the major contribution of bile to small intestine sodium loss after irradiation is the secretion of bile sodium rather than an action of bile acids on the intestinal transport process. (auth)

51999 INFLUENCE OF X-IRRADIATION ON SURVIVAL AND INTERFERON LEVELS IN VIRAL INFECTED MICE. **Hellman, A.; Martin, D. H.; Wopschall, L. J. (Oak Ridge National Lab., Tenn.). Proc. Soc. Exp. Biol. Med., 128: 455-8(June 1968). (ORNL-P-3400).**

The contributions of circulating macrophages and lymphocytes to survival of x-irradiated mice exposed to high doses of PR8 influenza virus were investigated. It was determined that when using host survival as an index, suppression of these cells and/or their functions had little influence on survival. Interferon levels when measured in sera and lung tissue of mice, showed no significant alteration in irradiated animals. The sex of the animal and splenectomy similarly did not influence the results. (auth)

52000 INFLUENCE OF WHOLE-BODY IRRADIATION, CORTISOL TREATMENT, AND ADRENALECTOMY ON INTERFERON INDUCTION IN VIVO IN RATS. **De Somer, P.; De Clercq, E.; Billiau, A. (Univ., Louvain, Belg.). pp 230-43 in Medical and Applied Virology: Proceedings of the Second International Symposium. Sanders, Murray; Lennette, Edwin H. (eds.). St. Louis, Warren H. Green, Inc., 1968.**

Sublethal (400-R) whole-body x irradiation potentiated endotoxin in inducing circulating and spleen interferon in the rat. The effect lasted from four hr to four days after irradiation. Lethal irradiation (1000 R) initially had the same potentiating effect as sublethal treatment, but four days later the animals began to die and in the remaining rats the serum interferon response declined to almost zero. However, the concentration of interferon in the spleen of these animals still equalled the control values, but because of the reduced size of the spleen, this represented only $\frac{1}{3}$ of the total amount of interferon present in control spleens. Data on the influence of sublethal irradiation on the induction of interferon by Sindbis virus indicated a slight inhibitory effect. Cortisol pretreatment reduced the interferon response to endotoxin in rats, but not in Sindbis virus-injected rats and mice. Adrenalectomy potentiated the interferon-inducing capacity of endotoxin in rats. (BBB)

52001 INCORPORATION OF ^{32}P INTO THE PROTEINS OF THE BLOOD SERUM AND INTO THE LIVER AND THE BRAIN OF RATS IRRADIATED WITH HIGH-ENERGY PROTONS. **Govorun, R. D.; Orlianskaya, R. L. Kosm. Biol. Med., 1: 41-4(Nov.-Dec. 1967). (In Russian).**

The distribution of ^{32}P isotope in the protein of the blood serum, the liver, and the brain of a group of 120 rats bombarded with 300, 600, and 1000-rad doses of 660-MeV protons was investigated. Changes in the distribution of injected ^{32}P in irradiated rats are discussed. (IAA)

52002 EXPERIMENTALNI POSTIRADIACNI SYNDROM. (Experimental Post-Irradiation Syndrome). **Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. 304p.**

Separate abstracts were prepared for each of the 23 chapters in the book. Included in the text are 139 photographs and 60 tables. In individual chapters a review of the most important references is presented. (B.S.L.)

For abstracts of individual chapters see: 51475–51485, 51669, 51861, 51864, 52003–52009, 52011, and 52014.

52003 RESEARCH CONCEPTS IN RADIOBIOLOGY. **Dienstbier, Z.; Zicha, B. pp 10-13 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).**

The present views on research conception in radiobiology are summarized. The necessity of the study of subcellular and cellular investigation and response of the organism are emphasized. The phases of post-irradiation damage are divided into four phases, including: excitation of water molecules, formation of molecular hydrogen and hydrogen peroxide, formation of radicals of water molecules, ionization and excitation of other molecules caused by direct or indirect effects; chemical change leading to the loss of specific characteristics of attacked molecule; modification of biochemical and physiological processes in the latent period; and secondary changes. As far as the determination of primary metabolic post-irradiation damage and the study of its possible affection are concerned, the second phase is the most important. Radiobiology of the clinical character, however, faces problems of diagnostics and therapy of the post-irradiation syndrome in living organisms where the processes due to primary effects prevail. The research in this line has sometimes to forestall the basic investigation of biological effects of ionizing radiation. It may at the same time contribute towards the elucidation of causes of pathophysiological post-irradiation changes. Cooperation of experts in several branches of research is necessary to elucidate the causes of pathological and physiological changes observed in patients following exposure to ionizing radiation during diagnosis or therapy. (auth)

52004 RADIATION EFFECTS ON SERUM PROTEIN CHANGES IN PERIPHERAL BLOOD. **Zicha, B. pp 75-84 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).**

Serum protein changes in the peripheral blood following irradiation were studied. A significant increase of serum $\alpha 3 + 4$-globulins following whole-body irradiation with a dose of 600 R was observed in the peripheral blood of dogs. This fraction contained the main portion of serum glycoproteins (evaluated as PAS of positive compounds by paper electrophoresis). Parallelly the content of bound hexoses and serum mucoids, as well as the intensity of polarographic reactions significantly increased. The increase of all these values in the blood of irradiated dogs had a progressive trend in course of the radiation sickness and reached the maximal value in the final phase of the disease after massive irradiation. The following of these values was of a significant diagnostic and prognostic importance. Serum glycoproteins were significantly increased in rats after administration of ACTH and cortisone. These hormones increased the radiosensitivity of rats and simultaneously increased the values of glycoprotein. It was concluded that degradation products of connective tissues with their functional integrity controlled by ACTH and corticosteroids contributed to the increase of polysaccharides in the blood of irradiated animals. Thus, the augmentation of glycoproteins following irradiation corresponds rather to the nonspecific reaction of the entire organism and does not seem to be a response of a specific postirradiation damage. The glycoprotein level indicates the activity of the organism and depends on individual radiosensitivity of irradiated animals. The animals with low initial level of glycoproteins generally survived for a period of 30 days after the exposure with a dose of 600 R, but the animals with high initial levels of glycoproteins died. (auth)

52005 CHANGES IN LYMPHATIC SYSTEM DURING ACUTE RADIATION SICKNESS. **Pospisil, J.; Zicha, B. pp 88-93 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).**

Whole-body x irradiation of dogs with a dose of 600 R caused a decreased penetration of proteins labeled with Evans Blue from the lymphatic system into the blood and vice versa up to the 15th day after irradiation. By perfusion of the lymphatic system by dextrane no damage of membranes of lymphatic vessels was found. No effects upon the activity of hyaluronidase in the blood of whole-body irradiated dogs occurred. By means of two-stage lymphography a slow disappearance of crystalloid contrast compound (Triopac) from the lymphatic flow 24 hours following irradiation was demonstrated. From the results obtained it was concluded that acute radiation exposure caused no change in the permeability of the walls of lymphatic capillaries. (C.H.)

52006 STUDIES OF PENETRATION OF MICROBES FROM INTESTINES INTO ORGANISM OF IRRADIATED DOGS. **Kunstyr, I.; Pospisil, J. pp 94-6 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).**

Investigations on the penetration of bacteria from the intestines of irradiated dogs (600 R) are reported. Serratia marcescens was used for testing. It was found that during 24 hours and 5 days following irradiation the germs penetrated into mesenteral lymphatic nodes in irradiated as well as in non-irradiated dogs. Serratia marcescens penetrated into the lymph and into blood, and rarely into abdominal organs and large intestine, of irradiated

dogs, but in non-irradiated dogs the finding was negative. On the 15th day following irradiation the percentage of positive results decreased and in the control non-irradiated groups was continuously negative. (auth)

52007 DYNAMICS OF PERIPHERAL CHANGES FOLLOWING IRRADIATION. Dienstbier, Z.; Arient, M.; Pospisil, J.; Smid, A. pp 107-26 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

A review is presented of the dynamics of changes in peripheral blood after external irradiation and after incorporation of internal emitters. Nonspecific changes such as the initial leukocytosis caused by neutrophilia and specific changes such as immediate lymphopenia and decrease of other blood elements are discussed. It is pointed out that reticulocytosis occurs after incorporation of relatively small activities of various radioisotopes. Post-irradiation changes are divided into four phases. The first phase is characterized by leukocytosis with initial lymphopenia, the second phase by permanent decrease of all kinds of cells circulating in blood, the third phase by the decrease of the amount of individual elements, and the fourth phase, when the number of blood elements start to return to normal values. The use of the relation between numerical blood changes and external irradiation doses for the diagnostic determination of biological damage is discussed. At a dose of radiation smaller than the LD_{min}, the lymphocytes decrease to less than 50% of normal values. The decrease does not last longer than one week. Neutrophilia nor neutropenia occurs, and very rarely a slight increase of the entire number of lymphocytes instead of decrease may occur after small doses of radiation. At a dose of radiation of approximately LD_{min}, lymphopenia is about 50% and lasts 2 to 3 weeks, neutrophilia is non-constant, and neutropenia appears in the 1st and 2nd week. At doses of radiation about LD_{50}, lymphopenia amounted to 25% of normal values and remained more than 4 weeks. There is an evident neutrophilia which turns into significant neutropenia on the 2nd to 5th day. Neutropenia lasts 3 to 7 weeks or until the animal dies. At the dose of radiation of LD_{100}, lymphopenia can be verified almost on the first day. In the first hours following irradiation, the neutrophilia which turns into neutropenia, is deeper than 25%. Neutropenia is significant in the first half of the first wk and lasts until the patient dies. It is necessary to take blood repeatedly in order to evaluate peripheral hematologic changes, dynamics and seriousness of the disease. After internal contamination the following changes observed included non-specific changes such as leukocytosis caused by neutrophilia, which appeared as a constant phenomenon only after the application of a greater amount of internal emitter with the affinity either to the blood-formation system or to the emitter with whole-body distribution and specific fluctuation of the amount of various kinds of peripheral blood elements according to the character of the emitter. Leukocytosis and especially lymphopenia belong to steady manifestations, however, in contradiction to the changes after external irradiation the drop of peripheral blood elements occurred more gradually, the extent of the decrease and the time course of these changes depended on the kind of the internal emitter. Great attention should be paid to reticulocytosis in spite of the fact that its level was not in correlation with the incorporated amounts of the emitter. A recovery of hemopoiesis following internal contamination is similar to recovery after external irradiation, but a complete normalization runs more slowly and there is a greater possibility of later chronical disturbances caused by the protracted radiation effects with emitters of a longer effective half-time. Great attention was paid to the functional activity of leukocytes and to slight morphological changes. After the administration of a higher dose, a significant disturbance of mobility and osmotic resistance of leukocytes was proved. Changes in the count of blood cells following irradiation seem to be one of the most important biological indices, which give information about the grade of the damage and these changes can also be applied as a prognostic guidance. (auth)

52008 BLOOD COAGULATION DAMAGES FOLLOWING IRRADIATION. Dienstbier, Z.; Arient, M.; Pospisil, J. pp 127-35 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Some factors causing blood coagulation damages following irradiation and possible application of coagulation tests for the diagnosis of the damage caused by fractionated small doses of radiation in men are discussed. Results are reported from studies of hemocoagulation damages in irradiated patients and professionals who were employed with ionizing radiation and on animals irradiated with a single dose. While in irradiated patients a gradual decrease of blood platelets depending on the applied dose and time of exposure was observed, in professional workers employed with ionizing radiation most frequently a disturbance of results of the prothrombin test occurred, mostly in cases without remarkable thrombopenia. A disturbance of thromboplastin generation test (TGT) in animals following single exposure was noted. A correction was achieved by removing the thrombocytes of the irradiated animal with blood platelets from the non-irradiated animals. It was concluded that ionizing radiation predominantly affects the first phase of coagulation. Functional disturbances of blood platelets occurred mostly in the acute radiation sickness, while in the chronic phase other components took part in the disturbance of active thromboplastin formation. (auth)

52009 IONIZING RADIATION EFFECTS ON THE BONE MARROW HEMOPOIESIS. Arient, M.; Dienstbier, Z.; Smid, A.; Pospisil, J. pp 136-82 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

In spite of the fact that the evaluation of the count of the blood cells and of morphology of cells in the peripheral blood following irradiation may be applied as a good guidance in the determination of the grade of the damage caused by ionizing irradiation in the organism, changes in the bone marrow are more accurate indices. The blast cells and the growing stages of all series belong to the most radiosensitive cells and they elicit post-irradiation changes significantly and in a very short time. These facts were verified by results of experiments with dogs and rats after exposure with various doses of x rays (25, 100, 400, 600, and 1000 R) and after the application of internal emitters (^{24}Na, ^{32}P, ^{91}Y, ^{140}La, and ^{141}Ce). The evaluation of the percental composition of myelograms of experimental animals in various individual time intervals provided reliable information about basic characteristics of the marrow reaction to ionizing irradiation (e.g., about more frequent changes and more rapid recovery of the red component in comparison with the white component), but it does not give detailed information about blood-formation. Without the estimation of an absorbed dose of x radiation of the same energy, the results obtained after external irradiation of small and big dogs are so different that in comparison with relative changes in myelograms no correlation between the surface irradiation dose and damage of the organism can be found. The significance of the determination of absolute values of individual kinds of cells in the marrow is emphasized, since based on this determination an approximately similar picture of hemopoiesis is obtained by means of histological methods. The results of tests performed on rats following external irradiation and after the application of various internal emitters are discussed and compared with the detailed information obtained by quantitative analysis of myelograms. This method of evaluation of the changes enables a better comparison of relations between the absorbed dose of radiation and the extent of biological damage of the bone marrow, especially after higher doses of irradiation. A rather complicated situation occurs after the application of internal emitters where several factors, especially the kind of irradiation, physical properties, and distribution of the emitter in the organism are of great significance. The experiments proved a higher sensitivity of erythroid cells in the marrow to irradiation after the administration of ^{32}P as compared with external irradiation. The most frequently occurring morphological changes of marrow cells, which can be considered as a post-irradiation effect of the formation, are presented. (auth)

52010 RESTORATION OF REGENERATIVE CAPACITY IN IRRADIATED AXOLOTL LIMBS BY GRAFTS OF DIFFERENT HETEROTOPIC TISSUES. Lazard, L. (College de France, Paris). J. Embryol. Exp. Morphol., 18: 321-42 (Dec. 1967). (In French).

Axolotl limbs irradiated with an appropriate dose of x rays (5000 R) did not regenerate. To determine whether tissues from outside the regeneration fields can form a blastema, attempts were made to restore regeneration by grafts of tissues from different sites. Skin from the crown of the head did not restore regeneration. Belly skin, taken from different neutral regions outside the irradiated field, restored regeneration in 20% of the samples. There was significant difference in the restorative capacity of the different regions. The frequency of regeneration was not improved if the grafted belly skin had recently regenerated, nor if it was maintained at 4°C for 24 hr before transplantation. Regenerates obtained from ventral skin grafts were frequently hypomorphic. Grafts were transplanted from embryos at different stages (from morula to tailbud stage), including the anlagen of two or three germ layers (ectoderm, mesoderm, endoderm). Among the regenerates which developed from these grafts, the best results were obtained with gastrula mesoderm (29%) and anterior limb buds from the tailbud stage (31%). Embryomas also developed, some of which bore regenerates at their extremity.

Histological study showed that these embryomas represented differentiations of the implants according to their origin in the donor. Regenerates obtained from embryonic grafts had an abnormal orientation and were sparsely pigmented and transparent. (BBB)

52011 PROBLEMS OF POST-IRRADIATION DAMAGE INDUCED BY SMALL FRACTIONATED RADIATION DOSES. Dienstbier, Z.; Pospisil, J.; Pazderka, V. pp 183-90 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Results are reported from replies to a questionnaire sent to physicians employed with ionizing radiation. Data showed that radiation dermatitis and changes in the blood-formation system were the most frequently occurring postirradiation damages in humans. In children born in families where one or both of the parents were employed in establishments using ionizing radiation, more frequent occurrence of physical defects during adolescence were found. Experiments with chronic irradiation of mice at doses of 3 R weekly showed a decrease in the birth-rate in the first generation and in the fourth irradiated generation sterility in most animals was proved. As far as hematologic changes in irradiated mice are concerned, a significant tendency to lymphocytopenia and in the last third of life to anemia was observed, the degree of which deepened in further generations of irradiated mice. In dogs irradiated during their whole life with a dose of 5 R daily, the hematological response was more uniform. At first leukocytosis caused by neutrophilia occurred up to an entire dose of 300 R, then it was changed gradually into leukopenia, in which especially lymphocytopenia participated. In spite of the fact that the results are in agreement with literary data, it was concluded that these results cannot be generalized until the reproducibility of the findings in a greater number of experimental animals is proved. (auth)

52012 OBSERVATIONS ON THE PHENOMENA OF TOOTH ERUPTION. Gowgiel, Joseph M. (Loyola Univ., Chicago). J. Dent. Res., 46: 1325-30(Nov.-Dec. 1967).

The experiments described resulted from an incidental finding in previous experiments on the pathogenesis of osteoradionecrosis. Irradiation was used to prevent root formation, eliminating the periodontal ligament and pulpal proliferation from consideration in tooth eruption. The maxilla and mandible of 10-day-old male Holtzman albino rats were x irradiated with a single massive dose of 2000 R. The rats tolerated this dose without death or illness. This dose caused a permanent cessation of further root formation in the molars, and temporary cessation of tooth formation in the incisors. However, even though the molar teeth were rootless, they erupted, more slowly, into the oral cavity and were in occlusion. The eruption rate of the incisors was also reduced. Since the maxillary incisors were generally out of the field of irradiation, this disturbance of the eruption rate often produced malocclusion of these teeth. The rootless molars did not show as many cellular and tissue changes as did the incisors. The follicular sac of these molars demonstrated changes in cell and fiber size, number, and orientation and were interpreted as a growth of the follicle. On this basis, tooth eruption was interpreted as resulting from follicular sac growth. The incisors demonstrated that the connective tissue cells were more radiosensitive than the epithelial cells. In most instances, the involuted odontoblasts, ameloblasts, and mesenchymal cells regenerated, and the formation of a normal incisor occurred. This phenomenon of recovery was previously recognized as the formation of a second incisor. (BBB)

52013 ASSESSMENT OF RADIATION AND CHEMICAL DAMAGE IN CULTURED MAMMALIAN CELLS. Fox, Margaret; Nias, A. H. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). J. Physiol. (London), 197: 52P-3P(July 1968).

The survival of single cells was estimated by their ability to grow into clones of a minimum size. Cells which attach to glass (e.g., Chinese hamster fibroblasts and HeLa epithelial cells) formed clones as a monolayer. Cells which grew in suspension (e.g., P388F mouse lymphoma cells) could be confined as clones by the addition of agar to the growth medium. The effects of continuous irradiation were shown in continuous cultures of all populations. Growth curves were obtained by serial counts of the total cell number. Using tritiated water in the growth medium as a source of continuous irradiation, the effect of increasing the dose rate was shown as a reduction in the growth rate of the cell populations. This was also dependent upon the proliferation rate of the cells; a similar dose per day might show different effects upon different cells. When the irradiation was considered in terms of dose per cell cycle, the effect was similar upon different cells. After acute irradiation of single cells the loss of clone-forming ability was also dose dependent. Cell survival curves were exponential in shape after an initial shoulder. The slope of the exponential portion provided a measure of the radiosensitivity. P388F cells were more radiosensitive (D_0 90 rad) then HeLa cells (D_0 150 rad) or Hamster cells (D_0 200 rad). This sensitivity changed when cells were treated with radiation of different quality, such as fast neutrons or when cells were pretreated with nontoxic doses of the halogenated pyrimidines (iodo- and bromodeoxyuridine). (BBB)

52014 REVIEW OF METHODS, EXPERIMENTAL CONDITIONS, AND TECHNIQUES IN IRRADIATION. pp 272-6 of Experimentalni Postiradiacni Syndrom. Dienstbier, Z.; Arient, M. (eds.). Praha, Czechoslovakia, Statni Zdravotnicke Nakladatelstvi, 1966. (In Czech).

Methods and evaluation of experimental conditions such as irradiation technique, food, stabling of animals and other related topics are discussed. (auth)

52015 INFLUENCE OF TEMPERATURE ON THE SUSCEPTIBILITY OF THE OLD-FIELD MOUSE (PEROMYSCUS POLIONOTUS) TO ACUTE RADIATION. Williams, Roger G.; Carmon, James L.; Smith, Michael H. (Univ. of Georgia, Athens). Contracts AT(40-1)-2975; AT(38-1)-310. Radiat. Res., 35: 709-13(1968). (ORO-2975-8).

The $LD_{50(30)}$ was 1147 ± 15 R for the old-field mouse, Peromyscus polionotus, following exposure to γ radiation. Radioresistance, as measured by this value, was not affected by sex or temperature over the range of 16° to 32°C. The variance of the $LD_{50(30)}$ for the 16°C group was significantly higher than that of the other two groups. The time until death after irradiation of the mice that died within 30 days was significantly affected by temperature and radiation level, and their interaction, but not by sex. (auth)

52016 CARCINOMA OF THE BRONCHUS WITH HYPONATREMIA TREATED BY RADIOTHERAPY. Fielding, J. F. (Queen Elizabeth Hospital, Birmingham, Eng.); Grande, R. A. Brit. J. Dis. Chest, 60: 137-43(July 1966).

Biochemical changes in response to irradiation were studied in a patient with oat-cell carcinoma of the bronchus accompanied by low serum Na levels. No attempt was made to correct this biochemical abnormality, as it gave rise to no symptoms. A course of x irradiation was begun and a tumor dose of 3000 R in 10 treatments was given by telecobalt. The results of investigations carried out before, during, and after x irradiation are shown graphically. A rise in Na and Cl serum concentrations and serum osmolality, with commensurate fall in urinary salt loss, was first noted 18 days after the completion of radiotherapy, plasma volume (45.7 ml/Kg body weight) remaining normal. No increase in urinary aldosterone (2.2 μg/24 hr) occurred to account for this. It is not known if a diuresis had occurred. An acquired proximal renal tubular defect may occur in this syndrome, urinary Na and Cl loss resulting from inability of the distal tubule to reabsorb the excessive Na load presented to it. In this case, radiotherapy seems to have ameliorated the defect. An increase in urinary antidiuretic hormone activity (45 milliunits/24 hr) was demonstrated after radiotherapy, to which the primary tumor responded satisfactorily. (TSS)

52017 EFFECT OF ULTRAVIOLET LIGHT ON THE EPIDERMIS. Szabo, Eva; Horkay, Iren (Univ. Medical School, Debrecen, Hungary). Acta Morphol. Acad. Sci. Hung., 15: 71-80(1967).

Histologic changes occurring in the human epidermis as an effect of uv irradiation were examined. A Hg vapor lamp (Medicor type 250; wavelength 360 mμ) was used to give doses of 4 and 8 SED, measured by the skin erythema dose (SED). Results of microscopic examination of tissues at 4 hr to 3 days post-irradiation are given in detail. (TSS)

52018 DIRECT PERCEPTION OF X RAYS BY THE HUMAN EYE. Schober, H. (Univ., Munich). Vision Res., 4: 251-69 (Aug. 1964). (In German).

Quantum statistical calculations were made to determine the energy conversion during direct visibility of x rays. Experiments were conducted in the voltage range between 70 and 100 kV. During the summation time about 50 x-ray quanta were needed to reach the visibility threshold. The laws of Ricco, Bunsen and Roscoe, and Graham and Margaria, concerning the influence of area and time of stimulation, were also confirmed for direct x-ray perception. The summation time was in the range of 40 msec. The biological Schwarzschild exponent calculated for visible light (0.7 for large and 0.5 for small stimulus areas) also held for direct x-ray perception. To produce a constant effect in a single retinal element, a lower energy is needed than that provided by a single x-ray quantum at 0.4 Å. For calculations of retinal energy conversion in the x-ray range, the photoelectric model of Autrum and Esper was found to be applicable. This model was also helpful in estimating exposed areas. (BBB)

Radiation Effects on Plants

Refer also to abstracts 51378, 51396, 51492, 51512, 51513, 51518, 51522, 51523, 51528, 51535, 51536, 51540, 51542, 51543, 51547, 51689, 51690, 51832, and 51869.

52019 POLYSACCHARIDES OF YEASTS DIFFERING IN RADIOSENSITIVITY. Saubenova, M. G.; Remezova, T. S. (Inst. of Microbiology, Moscow). Microbiology (USSR) (Engl. Transl.), 36: 841-4(Nov.-Dec. 1967).

The carbohydrate composition of yeast cells related genetically but differing in their radiosensitivity and reactivation potential was studied to determine whether the level of carbohydrate availability was correlated with resistance of yeast cells to the action of ionizing radiation. Yeast cells (Saccharomyces vini, S. lactis, Torulopsis dattila, and T. sphaerica), grown on wort-agar medium, had a high content of intracellular carbohydrates. The highest content of intracellular carbohydrates was found in cells of saccharomycetes. The radioresistant species (LD_{50}, 25 Krad), S. vini and T. dattila, differed from the genetically related but radiosensitive species (LD_{50}, 3 Krad), S. lactis and T. sphaerica, in their higher content of total carbohydrates and also in the principal reserve polysaccharide, glycogen. Because of the comparatively low endogenous respiration of S. lactis and the relatively high content of reserve polysaccharides, the energy-yielding processes in this yeast were not limited by a deficiency of carbohydrate substrates. However, as a result of the high level of endogenous respiration of T. sphaerica, this microorganism, with its comparatively small carbohydrate reserves, evidently lacks endogenous substrates which may be reflected in its irradiation response. Composition of the nutrient medium had an important influence on the carbohydrate content in yeast cells. However, on Rider's sucrose-mineral medium, despite a marked decrease in the total polysaccharide content, the same general pattern was observed: radiosensitive cultures differed from radioresistant in their lower content of reserve carbohydrates. (BBB)

52020 DISTRIBUTION OF ERGOSTEROL IN CELLS OF SACCHAROMYCES CEREVISIAE OBTAINED FROM IRRADIATED CULTURES. Dupuy, P.; Maugenet, J.; Morfaux, J.-N. (Station de Technologie Vegetale, Versailles, France). Ann. Technol. Agr. 15: 327-34(1966). (In French).

Ionizing irradiation of yeast causes an increase of the sterol content of the cultures. Experiments were conducted on the CC 53-1 strain with doses of 20 KRad of ^{60}Co γ radiation given to actively growing cultures. Whether the increase of sterols observed in cultures irradiated during growth is produced by giant cells especially rich in this compound was studied. To test this possibility the sterol content was compared in two yeast populations coming from the same culture, where large and small cells were in different proportions. Such enrichment in cells of different sizes was obtained by differential centrifugation. The sterol content was the same in the two populations although the mean weights of the cells were different by 30%. Most of the ergosterol was located in the particles spun down between 1000 and 30,000 g. Such particles contained 11 to 16% of ergosterol in free and esterified form, respectively. The cell wall also contained a small quantity of ergosterol which was mostly esterified. Ergosterol content increased in irradiated cultures in all cell fractions studied, from a control value of 3.4 to 4.3% (dry wt) in whole cells, from 1.5 to 2.2% in cell walls, from 11.9 to 16.5% in the particulate fraction, and 0.3 to 3.6% in the soluble fraction. (BBB)

52021 EFFECT OF IONIZING RADIATION ON LIPID BIOSYNTHESIS IN YEASTS. Larikova, G. A.; Gal'tsova, R. D. (Inst. of Microbiology, Moscow). Microbiology (USSR) (Engl. Transl.), 36: 800-3(Nov.-Dec. 1967).

Various yeasts were irradiated, in the form of packed cells, with 100-KV x rays at 3000 R/min, and changes in lipid content were determined after culture of irradiated cells. Considerable increases in the total lipid and sterol content were found in yeast cells grown on skim milk-agar medium following irradiation. The increase of lipid content was especially high in Saccharomyces cerevisiae (150%), S. carlsbergensis (127%), S. vini (200%), and E. magnusii (146%) following irradiation with 200 KR. The composition of the total lipid fraction of the irradiated cells did not differ from that of nonirradiated cells. In both, thin-layer chromatography showed 6 spots with the same distribution pattern, but chromatographs of the irradiated material differed from those of the controls in color intensity and size of some spots. The di- and monoglyceride and the phospholipid spots did not differ significantly in size in the experimental and control samples, but the triglyceride and sterol ether spots in the chromatographs of irradiated material were significantly larger than the corresponding spots in the control material. (BBB)

52022 NUCLEIC ACID METABOLISM IN ONTOGENESIS OF NORMAL AND gamma-IRRADIATED BARLEY. Chopiak, A. M.; Boudnitskaya, E. V.; Stoletov, V. N. (Inst. of Biochemistry, Moscow). Biokhimya, 33: No. 1, 34-42(1968). (In Russian).

During ontogenesis in nonirradiated barley the content of DNA, RNA, protein, and phosphorus-containing compounds of acid-soluble fractions increases progressively. During development of the reproductive organs the biosynthesis of DNA and RNA exceeds that of protein. In germinating seeds, seedlings, adult plants, and ears grown from irradiated seeds the content of DNA and RNA attained the level of that in plants grown from nonirradiated seeds only after complete maturation of the plants. Irradiation of seed resulted in pronounced inhibition in nucleic acid metabolism in ontogenesis, which was not always followed by restoration to normal levels. Irradiation of seeds during ontogenesis of barley caused interruption between the biosynthesis of nucleic acids and that of protein, as well as between biosynthesis of nucleic acids and phosphorus-containing compounds of the acid-soluble fraction. (BBB)

52023 THE SITE OF PHOTOREACTIVATION OF REPRODUCTIVE ABILITY IN THE ALGA NETRIUM DIGITUS AS DETERMINED BY EXPOSURE TO A MICROBEAM OF VISIBLE LIGHT. Marcenko, E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Bot., 8: 325-38(Aug. 1968).

The site of photoreactivation in the alga Netrium digitus was studied. Survivals of uv irradiated cells were compared after exposing different parts of the cells to microbeams of visible light. Illumination of the nucleus brought about a considerable reversal of uv induced damage of reproductive ability, while illuminating the area of the cytoplasm and the chloroplast had almost no effect. When the size of the illuminated area was increased, however, some photoreactivation could be detected after illuminating chloroplasts and cytoplasm. Illuminations of nuclei with microbeams of different sizes, the larger of which exposed much of the surrounding cytoplasm, showed that higher survival occurred with the smaller but more intense beams that were absorbed mainly by the nucleus. These experiments indicate that the site of photoreactivation of reproductive ability is primarily associated with the cell nucleus. (auth) (UK)

52024 INFLUENCE OF TRACE ELEMENTS ON THE SENSITIVITY OF SEEDS TO FAST FISSION NEUTRONS. Ponomarev, G. V. (All-Union Scientific Research Inst. of Horticulture, Leningrad). Radiobiologiya, 8: 448-52(1968). (In Russian).

Within the range of fast fission neutron tissue doses up to 600 RAD, no changes could be established in the radiosensitivity of barley seeds preliminarily germinated on a medium with an increased amount of boron. Preliminary germination on a medium with an increased amount of zinc increases the resistance of the seeds to fast fission neutrons. Preliminary germination against a background of polyvalent cations (Fe, Mn, Co) increased the sensitivity of the seeds to fast fission neutrons. A relationship was noted between the increase in the radiosensitivity of the seeds and the maximum valence of the metal ions. (JPRS)

52025 RESTORATION OF RADIATION DAMAGES TO COTTON SEEDS DURING PROLONGED STORAGE. Berezina, N. M.; Narimanov, A. A.; Revin, A. F.; Norbaev, N. (Inst. of Biophysics, Puschino, USSR). Radiobiologiya, 8: 438-41(1968). (In Russian).

It was established that cotton seeds irradiated at a lethal dose of 40 kR show a restoration of the viability lost under the influence of irradiation when they are stored for prolonged periods under laboratory conditions. All the seeds freshly irradiated at this dose die in the stage of the cotyledon leaves. Seeds stored for 6 and 12 months after irradiation develop true leaves, buds, and bloom. The restoration of viability is paralleled by a restoration of a whole series of physiological and biochemical disorders, arising in the freshly irradiated seeds: the chlorophyll content is restored, as is the activity of oxidative enzymes, and the content of radiotoxins is reduced. During prolonged storage of irradiated cotton seeds, a decrease in the radiation damages arising during irradiation of air-dried seeds at a dose of 40 kR is observed. (JPRS)

52026 DEVELOPMENT OF THE EMBRYO IN TRITICUM DURUM FOLLOWING IRRADIATION OF MALE OR FEMALE GAMETE. Donini, B.; Hussain, S. (CNEN, Rome). Radiat. Bot., 8: 289-95(Aug. 1968).

Data are reported on the relative effectiveness of acute irradiation of male or female gamete, (1500 R γ-rays (^{60}Co source)), on the development of embryo and endosperm in Triticum durum cv. Cappelli. The percentage of fertilization was lower in the irradiated male and female gamete groups than in the control group. Some stimulation in the development of the proembryo was observed 72 hr after pollination when the female gamete was irradiated; reduction in proembryo development was observed at 72 and 120 hr in the irradiated male gamete group. The endosperm was more advanced in its development in the irradiated male

gamete group when compared with both irradiated female and control groups. Several abnormalities (variation in cell size, cell vacuolization and cell degeneration) were also observed in the irradiated material. The observations show that irradiation of male gametes produces a more deleterious effect on the development of the embryos than irradiation of the female gametes. (auth) (UK)

52027 INCREASED RESISTANCE TO TOBACCO MOSAIC VIRUS IN GAMMA IRRADIATED TOBACCO LEAVES. Kuhn, C. W.; Teas, H. J. (Univ. of Miami, Coral Gables, Fla.). Radiat. Bot., 8: 317-23(Aug. 1968).

Gamma irradiation of tobacco leaves prior to inoculation with tobacco mosaic virus was found to decrease the size and number of local lesions. This phenomenon of virus inhibition by host irradiation was observed on both detached leaves and intact plants; similar results were obtained using two tobacco lines of diverse genetic background and three strains of tobacco mosaic virus. The inhibition of lesions was associated with reduced yield of virus and was not attributable to ozone or temperature increase in the irradiator during treatment. It is suggested that tobacco leaf irradiation is effective in reducing the number and size of lesions through inhibition of TMV multiplication. (auth) (UK)

52028 EFFECT OF ACRIFLAVINE ON ULTRA-VIOLET SENSITIVITY OF NORMAL, ULTRA-VIOLET SENSITIVE, AND ULTRA-VIOLET RESISTANT STRAINS OF A BLUE-GREEN ALGA, ANACYSTIS NIDULANS. Singh, H. N. (Univ. of Udaipur, Rajasthan, India). Radiat. Bot., 8: 355-61(Aug. 1968).

The effects of acriflavine (AF) administered before and after uv radiation on the survival of three strains (S–normal, S/R^s–uv sensitive, S/R^r–uv resistant) were investigated. The variable nature of the extrapolation numbers and the similarity of the final slopes of the survival curves indicated that the initial lethal lesions produced by uv radiation were the same in all three strains, and that differences in uv survival can be accounted for by differences in their capacity to cope with such lethal lesions. Decreased survival induced by post-irradiation treatment with acriflavine in S and S/R^r but not in S/R^s seems to indicate that S/R^s lacks a repair system. It is concluded that AF modifies the uv survival of S and S/R^r in opposing ways depending upon the timing of its application. (auth) (UK)

52029 COMPARATIVE EFFECTS OF γ AND UV IRRADIATION ON PRODUCTION OF HAPLOID SEEDS FROM LYCOPERSICUM ESCULENTUM. Turkov, V. D.; Dubrov, A. P. (Inst. of Biological Physics, Moscow. Inst. of General Genetics, Moscow). Dokl. Akad. Nauk SSSR, 181: 486-7(1968). (In Russian).

Production of haploid seeds of tomatoes, Lycopersicon esculentum, by pollination with pollen irradiated by ionizing and uv radiations was studied. The pollen was exposed to γ radiation doses of 6000 R 2 to 3 hr prior to pollination, and to uv irradiation directly before the pollination. The fruits of tomatoes pollinated by irradiated pollen had an irregular acentric shape. From 124 flowers pollinated by irradiated pollen 60% produced fruits, while with uv irradiation only 7.4% produced fruits. Preliminary cytogenetic analysis of seeds from 37 γ irradiated and 8 uv irradiated fruits revealed a comparatively high percentage of haploid seeds, and only 6 fruit exposed to γ rays revealed diploid seeds. It was concluded that ionizing and uv irradiation are effective measures for developing haploid tomato seeds. Pollination by pollen γ-irradiated with 6000 R produced the highest yield of haploid seeds. (R.V.J.)

52030 JOINT ACTION OF γ IRRADIATION AND THERMAL SHOCKS ON ARABIDOPSIS THALIANA (L.) HEYNH. SEEDS. Nikolov, Ch. V.; Ivanov, V. I. (Moscow State Univ. Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 442-7(1968). (In Russian).

Air-dried seeds were subjected to γ irradiation at doses of 40, 80, 120, and 160 kR, as well as to a temperature influence of 100°C for 30 min. Thermal shocks were applied before, after, or before and after irradiation. In the control and experimental groups of plants, death of the plants in the phases of the cotyledons and rosette, growth of the root and stem, the rate of passage through the basic phases of development, and fertility were studied. Postradiation thermal shocks intensified the effects of irradiation, while preradiation and double shocks weakened them. The possible mechanisms of the influence of thermal shocks upon the radiobiological responses of seeds are discussed. (JPRS)

52031 THE INTERPHASE CHROMOSOME VOLUME IN THE RADIOSENSITIVITY OF TRITICUM. Abreu, Maria de la luz; Villalobos-Pietrini, Rafael (Comision Nacional de Energia Nuclear, Mexico City). Bol. Inst. Estud. Med. Biol., (Mex.), 25: 83-90(Jan. 1968). (In Spanish).

Wheat seeds were irradiated in lots of 50 with ^{60}Co at 162 R/min for total doses of 25 to 85 kR. The samples included varieties with various degrees of radiosensitivity: Triticum monococcum var. Einkorn R61-62 (diploid with a chromosome no. (2n) of 14); T. durum var. Oviachie 65 (tetraploid, 2n = 28); and T. vulgare var. Lerma Rojo 64A (hexaploid, 2n = 42). Nuclear and nucleolar volumes were compared with radiosensitivity data based on the 20-day ($LD_{50/20}$) survival. The results showed the use of the variable interphase chromosomal volume obtained by the difference of nuclear volume minus nucleolar volume is useful in ascertaining the radiosensitivity of a polyploid series of Triticum. It showed that the increase of ploidy is an efficient mechanism for protection against ionizing radiation. For T. monococcum, T. durum, and T. vulgare the $LD_{50/20}$ values were 26.92, 37.15, and 69.18 kR, respectively; the energy absorbed per interphase chromosome at the LD_{50} (X 10^3 keV) was 23.43, 27.16, and 60.82; the proportion of protection at the LD_{50} was 1, 1.38, and 2.57; and the nuclear minus nucleolar volumes were 211.43, 354.85, and 640.72 μ^3. The latter values when plotted against the $LD_{50/20}$ values led to a linear relation. (BBB)

52032 QUANTITATIVE REGULARITIES OF THE POST-IRRADIATION RECOVERY OF YEAST CELLS IN DIFFERENT STAGES OF RADIOBIOLOGICAL EFFECT. Kapul'tsevich, Yu. G. (Inst. of Medical Radiology, Moscow). Radiobiologiya, 7: 913-5(1967). (In Russian).

Three-day diploid yeasts Saccharomyces vini (Megri 139-B strain) were γ-irradiated (^{60}Co) and their survival determined. The ratios of the number of colonies grown after 48 hrs of incubation to the numbers grown after 120 and 96 hrs of incubation were plotted as a function of the radiation dose and the survival curves. The quantitative characteristics of the postirradiation recovery of the yeasts were extremely stable and independent of temperature modifications. (JPRS)

52033 CYTOPHYSIOLOGICAL PECULIARITIES OF IRRADIATED APPLE POLLEN AND ITS FERTILIZING ABILITY. Dryagina, I. (Lomonosov State Univ., Moscow). Nauch. Dokl. Vyssh. Shk. Biol. Nauki, No. 2, 99-103(1966). (In Russian).

Apple trees of common varieties at an initial stage of pollen formation in May were irradiated for 7 days with a 4.4-Ci source of ^{60}Co γ rays administered at a level of tree branches. As development of the pollen advanced, total γ-ray doses of 0.2 to 14.5 KR were received by the pollen from various distances, at 30 R/min. The cytophysiological abnormalities of pollen induced by irradiation were evaluated on the basis of the hydrogen ion concentration (pH), while the staining of pollen was examined according to toluidine blue and peroxidase activity by a cytochemical method. The viability of pollen was evaluated on culture media (1% agar + 15% sucrose), and the fertilizing ability of pollen was determined by hybridization studies. The 45-day observations indicated that, in comparison with controls, markedly fewer pollen grains were germinated immediately after irradiation, particularly after irradiation of pollen with 7.5- to 10-KR doses, while the optimum dose for viability of microspores was 0.5 KR. As an example, irradiation during gametogenesis with the 14.5-KR dose yielded 88.9% of abortive pollen and the 10-KR dose induced a 69.9% yield. The magnitude of oxidation-reduction potential (rH) in irradiated pollen was somewhat lower than that of controls; its lowest value was observed after irradiation of pollen with 10- to 14.5-KR doses. Larger radiation doses, e.g., 5 to 14.5 KR, suppressed peroxidase activity, while 0.2- to 0.5-KR doses increased the activity above the level of controls and a higher level was maintained for 45 days. Generally, irradiation of pollen had no adverse effect on fertilizability and on setting of fruit; however, a dose of 10 KR caused a 16.1% decrease in the number of seeds in the apples. (BBB)

52034 RADIATION DAMAGE IN SHOOTS OF SWEET CHERRY (PRUNUS AVIUM L.). Pratt, Charlotte (New York State Agricultural Experiment Station, Geneva). Radiat. Bot., 8: 297-306 (Aug. 1968).

An anatomical study of radiation damage was made in growing sweet cherry buds exposed in a dormant condition to 0–8000 rads of γ-rays. Buds of Bing or Black Tartarian were fixed from dormant scions, from scions forced in water, or from growing shoots on recently budded rootstocks. The dormant buds contained an average of 7.1 foliage leaves and 2.5 leaf primordia. Secondary buds developed from the lower axillary meristems during bud burst. Irradiated buds on scions forced in water until the green tip stage showed radiation-damaged cells in the axillary

buds but not in the apical meristems. In buds established on rootstocks, such cells appeared in the leaf primordia, apical and axillary meristems, the vascular tissue and the pith. Radiation-damaged cells were characterized by darkly stained thickened cell walls, and the virtual absence of division. Irradiation greatly retarded the production of new leaves by the apical but not by the axillary meristems. The stratification of both apical meristems and axillary buds became increasingly disturbed as growth proceeded. Recovery of the apical meristem was not observed anatomically, but it evidently occurred, as shown by the absence of budless shoots or branching. The first seven leaves of a typical shoot from an irradiated bud showed a fine, light green or whitish mosaic; the next three leaves had a coarse mosaic; the next two to four leaves, the number increasing with dose, bore light green sectors; the remaining two to three leaves were normal. The number of leaves with different types of mosaic corresponded to the number and differentiation of leaves in the dormant bud. Radiation damage in shoot meristems of cherry was random in its distribution and recovery probably resulted from the activity of the less injured cells throughout the apical and axillary meristems. Patterns of radiation damage in apical meristems, as reported for higher plants, fall into three categories, localized, random or uniform. Random damage in buds has apparently not been previously described. (auth) (UK)

52035 STUDIES ON THE FLOWER INITIATION IN PHARBITIS SEEDLINGS. II. INFLUENCES OF GAMMA-RAY IRRADIATION. Wada, Kiyomi (Shizuoka Univ., Japan). Bot. Mag. (Tokyo), 81: 198-209(Apr. 25, 1968).

Growth and flowering of the seedlings of the Japanese morning glory, Pharbitis nil, irradiated with varying doses of ^{60}Co γ rays were studied. They were subjected to a single 16-hr dark period, then exposed to γ rays at a dose rate of 340 R/min for doses of 2500, 5000, 10,000, and 15,000 R. The higher doses severely affected not only the growth of plumule and cotyledons, but also flower initiation. When the seedlings were exposed to 2500 R, all buds, terminal and axillary, which were present at the time of irradiation, died, but later subsidiary buds developed. The leaf primordia present at the time of irradiation survived, and developed into abnormal leaves. The margins of these 3 or 4 leaves became irregular, and the leaf-blades became variegated with small white dots due to chlorophyll deficiency. Flower initiation was abolished in all lots irradiated with doses over 2500 R. Seedlings exposed to lower doses than 2600 R continued to grow to some extent, but with 1300 R or less there was no difference in appearance between irradiated and control samples. Low doses (below 330 R) promoted flower initiation when the seedlings were irradiated before the flower-inductive dark period. The influence of γ rays on flower initiation was different depending mainly on the time when the seedlings were irradiated. The reversion of flowerbuds to vegetative ones, and the appearance of various malformed types of flowerbuds were observed. A definite relation between the occurrence of the malformation and the time of irradiation was found. (BBB)

Radiation Effects on Microorganisms

Refer also to abstracts 51367, 51396, 51402, 51472, 51491, 51524–51527, 51529, 51532, 51534, 51539, 51541, 51553, 51690, 51869, 51936, 52075–52077, 52079, 52083, 52084, 52086–52090, 52098, 52101, 52123, 52125, and 53501.

52036 (ORO-3596-7) COMPARISON OF THE RATE AND EXTENT OF DEOXYRIBONUCLEIC ACID REPAIR AND SEMI-CONSERVATIVE SYNTHESIS IN BACTERIA EXPOSED TO ULTRAVIOLET LIGHT. Billen, Daniel (Florida Univ., Gainesville). Aug. 1, 1968. Contract AT(40-1)-3596. 16p. (CONF-680413-4). Dep. CFSTI.

From Symposium on the Effects of Radiation on Cellular Proliferation and Differentiation, Monaco.

Many bacterial strains possess the ability to repair genetic damage resulting from ultraviolet light (uv) exposure. Of major importance is the occurrence of a "repair" type of deoxyribonucleic acid (DNA) replication during "dark repair," which presumably results in the replacement of the damaged portion of the genome. Using deuterium, ^{15}N, and ^{13}C as a density label and buoyant density centrifugation in CsCl as a means of separating pre- and post-irradiation synthesized DNA strands, the rate and extent of DNA repair synthesis in exponential-phase Escherichia coli strain B/r was determined. After uv exposure, ^{3}H-thymine incorporation into the "heavy" parental DNA strands was used to measure repair synthesis; while ^{3}H-thymine incorporation into "light" and newly synthesized DNA strands measured semi-conservative replication. The rate of bases incorporated by repair synthesis in the initial 15 minutes of post-irradiation incubation at 37°C appears to be saturated at a dose of approximately 100 ergs/mm^2. At higher doses (up to 600 ergs/mm^2) the increase observed was not proportional to dose. During this initial 15 minutes, less than 1% of the chromosomal DNA was replaced. The amount of DNA synthesized by semi-conservative replication during the initial 15 minutes was reduced with increasing uv dose. After exposure to 600 ergs/mm^2, repair and semi-conservative DNA synthesis were nearly equivalent in the irradiated cells at the end of 15 minutes of incubation. Repair synthesis was observed to be terminated by 45 minutes in bacteria exposed to 160 or 500 ergs/mm^2 (64% and 10% survivors respectively). The amount of genome replaced by repair synthesis at several doses was determined. Starvation for a required amino acid (resulting in an inhibition of protein and ribonucleic acid synthesis) did not prevent the repair synthesis nor grossly alter its extent. The restoration of the semi-conservative mode of DNA synthesis was prevented by amino acid starvation. Since excision of pyrimidine dimers has been shown by others to be extensive at the doses used in these studies, it is proposed that at least a portion of the killing of "resistant" bacteria results from accumulation of discontinuities in the DNA strands due to saturation of the repair synthesis system. (auth)

52037 MULTIPLY RESISTANT STRAINS OF ESCHERICHIA COLI ISOLATED FROM THE URINARY TRACT. Vondraskova, Marie; Starka, J. (Charles Univ., Prague). J. Hyg., Epidemiol., Microbiol., Immunol., 10: 174-7(1966).

In many multiply resistant strains of Escherichia coli isolated in Prague hospitals from urine of patients suffering from urinary tract infection the resistance factor is integrated in the chromosome and can be released into the autonomous cytoplasmic state by uv irradiation. Bacterial suspensions were irradiated for 16 sec with a germicidal lamp (Philips TUV 30 W) before acriflavine was added. This dose of irradiation significantly increased the incidence of cells that were sensitive to the influence of acriflavine. The irradiation and the acriflavine treatment eliminated the resistance in nine out of 10 strains. Suspensions of four mutant types were irradiated and incubated with acriflavine. No loss of resistance to any antibiotic was found. (BBB)

52038 INFLUENCE OF γ RADIATION ON SOME OF THE BIOCHEMICAL PROPERTIES OF SOIL. Cawse, P. A. (United Kingdom Atomic Energy Authority, Wantage, Eng.). Biochem. J., 109: 3p(Sept. 1968).

Few organisms survive γ doses of 2 to 4 Mrads, but humus is relatively unaffected and the activity of phosphatase, urease, and some other enzymes remains intact. Increased plant growth in soil treated with 0.005 to 4 Mrads is mainly attributed to death and lysis of susceptible organisms, followed by nitrogen mineralization. In many soils the ammonium is rapidly oxidized by the surviving nitrifiers, and nitrate reaches a maximum between 0.2 and 0.8 Mrad; perfusion studies suggest that radiation prevents proliferation without affecting oxidation processes. Nitrification is gradually inhibited from 0.8 to 3 Mrads, with a corresponding increase in ammonium. In two organic calcareous soils treated over the range 0.6 to 2.5 Mrads nitrate appeared to form by reduction of nitrate, with maximum accumulation at the lower dose region. These are considerable differences in the lethality of radiation towards the microflora, both between and within the major groups such as fungi and bacteria. Microbial oxidation of sulphur shows a radiation response curve with two distinct slopes, indicating that separate organisms are involved. There is evidence for harmful and stimulatory effects on nitrogen fixation, and natural populations of Azotobacter are more radioresistant than laboratory grown bacteria. (auth) (U.K.)

52039 FINE STRUCTURE AND RADIATION RESISTANCE IN ACINETOBACTER: STUDIES ON A RESISTANT STRAIN. Thornley, Margaret J.; Glauert, Audrey M. (Univ. of Cambridge, Eng.). J. Cell Sci., 3: 273-94(June 1968).

An electron-microscope study was made of intact cells and isolated cell walls of a bacterium that was moderately resistant to ionizing radiation, Acinetobacter strain 199A (Achromobacter Sp.). A sigmoid survival curve with a D_{10} value of about 60 Krad in the exponential part of the curve was found. It was isolated from a chicken carcass γ-irradiated at 500 Krad. Results showed that it was similar to other Gram-negative bacteria except for its mode of division and for the fine structure of some of the surface layers. During division the cells formed a fairly thick septum similar to those observed in Gram-positive bacteria. An examination of the appearance and chemical composition of isolated cell walls before and after treatment with enzymes, detergents, and lipid solvents revealed that three layers, each with a characteristic fine structure, are present in the cell wall: an outer membrane with an array of peg-like subunits; a layer of wrinkled material that is digested by proteolytic enzymes; and a smooth, rigid layer that contains the mucopeptide components of the cell wall. It was

suggested that the wrinkled layer may be associated with the radiation resistance of the organism. (BBB)

52040 EFFECTS OF ULTRAVIOLET IRRADIATION ON THE TRANSFORMING AND PLAQUE-FORMING CAPACITIES OF SIMIAN ADENOVIRUS SA7. Casto, Bruce C. (Inst. for Biomedical Research, Education and Research Foundation, Chicago). J. Virol., 2: 641-2 (June 1968).

The experiments reported demonstrated that the radiosensitive region of the virus responsible for transformation by an adenovirus was also smaller than the region responsible for plaque formation. The SA7 virus used was propagated in BSC-1 cells and had a titer of 5×10^7 plaque-forming units (PFU)/ml in primary African green monkey kidney cell cultures. The uv-induced inactivation of SA7 virus infectivity followed first-order kinetics and remained linear throughout the irradiation period. A comparison of the inactivation curves of the transformation capacity (focus-forming units or FFU) and the infectivity (PFU) revealed that the inactivation rates for PFU and FFU were ~3.5 and 1.7%/sec, respectively. In a second experiment, the rates were 5.7 and 1.9%/sec. The calculated FFU/PFU slope ratios for the 2 experiments were 0.485 and 0.333. Virus multiplicity effects did not appear to be responsible for the increased survival of the transforming ability. These results suggested that the relative irradiation target size of the viral genome that is responsible for adenovirus transformation was less than half of that which was necessary to code for virus replication. (BBB)

52041 COMPARATIVE ANALYSIS OF LETHAL LESIONS PRODUCED BY ^{32}P DECAY AND GAMMA RAYS IN PHAGE T1 AND IN ITS HOST STRAINS OF ESCHERICHIA COLI WITH NORMAL AND REDUCED REPAIR ABILITIES. Ikenaga, Mituo (National Inst. of Genetics, Misima, Japan). Radiat. Res., 34: 421-36 (1968).

Phage T1 irradiated in vitro by γ-rays while suspended in broth was inactive when plated on radiation-sensitive strains B_{s-1} and R11 of Escherichia coli at a rate 1.2 times that found when it was plated on resistant strains H/r30 and H/r30-R; when inactivated in vitro by incorporated ^{32}P it gave exactly the same number of plaques on B_{s-1} as on H/r30. Sensitivity to killing of host strains H/r30, R11, and B_{s-1} was in the ratio of 1 : 1.2 : 4.0 for aerobic γ-irradiation, 1 : 1.2 : 6.3 for anoxic γ-irradiation 1 : 1 : 2 for aerobic ^{32}P treatment, and 1 : 1 : 2.2 for anoxic ^{32}P treatment. Ultracentrifugation analysis of ^{32}P-incorporated DNA of T1 supported the assumption that one lethal hit corresponded approximately to one double-strand break. Based on this evidence, the inactivation data for phage and E. coli were analyzed. It was concluded that ^{32}P killing of T1 was primarily caused by transmutation of ^{32}P, whereas ^{32}P killing of host bacterium was only partly caused by transmutation. It was estimated that transmutations were responsible for about 40% and 70% of lethal lesions induced by ^{32}P decay in strains B_{s-1} and H/r30, respectively; the rest being caused by β-rays. (auth)

52042 GENERAL PRINCIPLES OF RADIOSTERILIZATION. Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge). pp 3-22 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Developments in the radiosterilization of medical supplies are reviewed. Emphasis is placed on the direct and indirect effects of γ and x radiations on the survival of bacteria. Topics discussed include the relative radiosensitivity of bacterial species; the effects of environmental conditions such as medium, gas phase, temperature, and degree of hydration on radiosensitivity; the possibility of using chemical compounds to increase the radiosensitivity of bacteria; the combined effects of heat and radiation on the survival of bacteria; the induction of radioresistant mutants; the radiosensitivity of bacterial toxins; and other factors that may influence the survival of irradiated bacteria. (105 references) (C.H.)

52043 CULTIVATION OF FUSED CELLS RESULTING FROM TREATMENT OF CELLS WITH HVJ. I. SYNCHRONIZATION OF THE STAGES OF DNA SYNTHESIS OF NUCLEI INVOLVED IN FUSED MULTINUCLEATED CELLS. Yamanaka, Tadashi; Okada, Yoshio (Osaka Univ.). Biken J., 9: 159-75 (Sept. 1966).

Fusion of animal cells easily occurs with HVJ (hemagglutinating virus of Japan); the fusion activity of the virus particle is located in the envelope and is composed of lipoprotein. Its activity is more stable to uv irradiation than the infectivity of the virus. The cells fused by uv-irradiated HVJ synthesize as much DNA and RNA as control cells which have not been treated with virus. It would be expected that cellular regulation of multinucleate cells (heterokaryons) shifts from the parental mononuclear cells. DNA synthesis and cell division of heterokaryons were analyzed. Multinucleated giant KB cells fused by uv-irradiated HVJ were readily cultivated for several days in Eagle medium containing bovine serum. However, division of these fused cells was rarely seen. On the contrary, mononuclear cells grew actively in the same medium even after treatment with HVJ. The absence of division of the fused cells was evidently due to polynucleation of the cells and not to treatment with HVJ. DNA synthesis of nuclei in the fused cells was found to be high in mononuclear cells. KB cells were fused randomly by HVJ irrespective of their stage in the generation cycle. Immediately after fusion, G- and S-phase nuclei (corresponding to DNA synthesis) were distributed randomly in the multinucleated cell. When the fused cells were cultured, the stages of DNA synthesis in all the nuclei in a cell became synchronized, even though division of the fused cell was not seen. The time of culture of the cells required for the synchronization increased with increase in the number of nuclei involved in the fused cell. (BBB)

52044 EFFECT OF IONIZING RADIATIONS ON RESTING CONIDIA OF ASPERGILLUS FLAVUS. Kopelman, M.; Markakis, P.; Schweigert, B. S. (Michigan State Univ., East Lansing). J. Food Sci., 32: 694-6 (1967).

Conidia of A. flavus were exposed to the γ radiation of ^{60}Co and to 1-MeV electrons generated in a resonance transformer accelerator, and the effects of pH, dextrose, and water on the ability of these spores to form colonies after irradiation were examined. When spores were irradiated in water there was a linear relation between radiation dose and logarithmic survival of the spores with a D value equal to 38 Krad for both γ rays and electrons. In the absence of water the resistance of the spores to radiation was higher than in the presence of water and the dose-survival curve was not linear. There was no appreciable pH effect in the range of 3 to 7 on the radiation resistance of the spores. When the spores were irradiated in dextrose solution, a small increase in radiation resistance was observed as the sugar concentration was raised from 0 to 40%. (BBB)

52045 IONIZING IRRADIATION OF FOOT-AND-MOUTH DISEASE VIRUS AND ITS RIBONUCLEIC ACID. Polatnick, J.; Bachrach, H. L. (Plum Island Animal Disease Lab., Greenport, N. Y.). Arch. Gesam. Virsuforsch., 23: 96-104 (1968).

Changes in infectivity of ^{60}Co γ-irradiated preparations of foot-and-mouth disease virus (FMDV) are reported. The infectivity of FMDV preparations containing growth medium and cellular products was many times more resistant to inactivation by irradiation than was pure virus. About 4×10^6 RAD was required to reach a survival of less than 10^{-8} in experiments permitting only the direct absorption of radiation energy by the virus preparation. The infectivity of pure virus preparations was protected from radiation damage by cysteine and gelatin to a lesser extent than by growth medium and cellular products. Radiosensitivity was not increased by the addition of a sulfhydryl-binding reagent, p-hydroxymercuribenzoate. The RNA extracted from irradiated virus showed the same rate of infectivity loss as did the intact virus. The infectivity of free RNA, however, was more sensitive to irradiation than intact virus. RNA in the presence of gelatin had the same stability as intact pure virus. Absorbance-temperature measurements showed that loss of infectivity by pure virus was accompanied by degradation of the virus particles, loss of aromaticity in the purine and pyrimidine rings, and hydrolysis of the RNA backbone chain. (BBB)

52046 ANALYSIS OF THE LIFE CYCLE OF MYCOPLASMA PNEUMONIAE BY SYNCHRONIZED DIVISION AND BY ULTRAVIOLET AND X IRRADIATIONS. Furness, G.; Pipes, Florence J.; McMurtrey, M. J. (New Jersey Coll. of Medicine and Dentistry, Jersey City). J. Infect. Dis., 118: 7-13 (Feb. 1968).

Radiations were used to study development of M. pneumoniae, a single-celled organism dividing by binary fission on agar and in broth. In broth it was found in clusters of 8 organisms and had a growth cycle typical of bacteria, with a lag period of ~12 hr, a logarithmic phase, and a stationary phase on reaching 4.1×10^7 colony-forming units per ml broth. Elementary bodies were inactivated exponentially by uv and x irradiations, in contrast to aggregates. The generation time on agar and in broth was about 6.5 hr. On the basis of these criteria it is suggested that M. pneumoniae be classified in a new genus of the Mycoplasmatales, the Schizoplasma, type species Schizoplasma pneumoniae, and that the elementary body be termed a plasmion. Single organisms were homogeneous in their susceptibility to uv and x irradiations, whereas dividing organisms were heterogeneous. (BBB)

52047 PHOTOSENSITIZING ABILITY OF PRODIGIOSIN. Roth, Micheline Mathews (Boston City Hospital, Mass.). Photochem. Photobiol., 6: 923-6 (Dec. 1967).

Experiments demonstrating the ability of prodigiosin to photosensitize bacterial cells to uv light are reported. Serratia mar-

cescens, strain Hy and a colorless mutant of that strain which contains no prodigiosin precursors, were used. It was shown that the prodigiosin contained in the cells of S. marcescens does not act as a photosensitizer or a photoprotector when the cells are exposed to strong light alone, nor does its presence potentiate or inhibit the action of the photosensitizer toluidine blue. The absorption spectrum of prodigiosin contains bands absorbing in the uv range, but the rate of killing was the same for both the wild-type and the prodigiosin-less mutant. Thus prodigiosin is neither a photosensitizer nor a photoprotector when S. marcescens is exposed to uv light. However, in tests of prodigiosin as an exogenous photosensitizer, it was found that prodigiosin isolated from S. marcescens is capable of photosensitizing the cells of a white mutant of S. lutea, although prodigiosin was not capable of photosensitizing the pigmented and colorless cells of S. marcescens. This suggests that S. marcescens has a better permeability barrier than does S. lutea. Further investigation into the structure of the membrane complex of this organism may shed light on how a powerful photosensitizer was integrated into its structure in such a way that it poses no danger of endogenously photosensitizing the cell. (BBB)

52048 RESEARCH ON ATMOSPHERIC POLLUTION AND CONSIDERATIONS ON THE USE OF GERMICIDAL ULTRAVIOLET RAY LAMPS IN SANATORIA. Ferrari, S.; Lucchesi, M.; Maggini, P.; Praloran, L. (Univ., Rome). Ann. Ist. Carlo Forlanini, 27: 105-18(1967). (In Italian).

Biological and biophysical effects of uv radiation are reviewed, with a comparison of effects of x radiation and of the fundamental direct and indirect chemical reactions known to be caused by ionizing and nonionizing radiations. The role of H_2O in mediating the effects of these radiations, ultimately on the DNA molecule, is discussed. Some experiments on the effect of 2800 Å uv radiation on microbiological flora of a sanitorium were performed. To demonstrate the germicidal activity of uv lamps in the sanitorium, air samples from various rooms of the Carlo Forlanini Institute were studied microbiologically. To estimate the mycobacteria present in the air, samples were filtered by Miquel filters; a part of the residue on the filters was inoculated into selective media and a part was directly inoculated to guinea pigs. To detect common bacteria and mycetes, agar-Sabouraud plates were held in contact with air. This experiment was designed to investigate the microbe-killing efficacy when the lamps were operating. In total, 102.1 m^3 of air was filtered by 59 Miquel filters, 32% of which was positive for mycobacteria with a total of 134 colonies. Inoculation of guinea pigs with the colonies and/or residues on the filters did not cause tubercular disease. Moreover, mycobacterial typing tests confirmed that the isolated strains were saprophytes. Research on bacterial flora and on mycetes demonstrated that the use of uv lamps did not result in thorough sterilization of the surrounding air, but only a partial decrease of bacterial flora. To attain this result, the lamps must be used in rooms where air is not replaced rapidly. (BBB)

52049 INTERFERON PRODUCTION WITH STRAIN SE-4 OF PARAINFLUENZA-3 VIRUS. **Rosenquist, Bruce D.; Loan, Raymond W. (Univ. of Missouri, Columbia). Amer. J. Vet. Res., 28: 619-28(May 1967).**

Stimulation of interferon production by uv irradiation of virus was demonstrated in fetal bovine kidney cell (BEK) cultures infected with strain SF-4 of parainfluenza-3 virus (PIV-3). Unirradiated virus induced significant interferon synthesis, but virus irradiated with uv light for 20 and 40 sec and inoculated at input multiplicities of 1.0 induced the highest levels of interferon. Virus irradiated for longer periods induced lower or undetectable levels of interferon. Loss of viral infectivity followed first-order kinetics during the first minute of uv irradiation, beyond which the rate decreased. Dialysis against pH 2 buffer and uv irradiation for 2 min were undependable means of removing all residual infectivity from PIV-3-induced interferon preparations. The interfering substance resembled interferon, such as resistance to pH 2, nondialyzability, and destruction by trypsin. It did not have any direct effect upon challenge virus and was not affected by specific antiserum. It was relatively heat stable, resistant to ribonuclease, and not sedimentable by ultracentrifugation at 105,000 g. A lack of species specificity was found when tested in swine testicular cells. (BBB)

52050 MUTATION: AN APPRAISAL OF THE METHODOLOGY USED IN BACTERIAL GENETICS. **Ramakrishnan, T. (Indian Inst. of Science, Bangalore). J. Sci. Ind. Res., 27: 118-20(Mar. 1968).**

Various methods for isolating bacterial mutants induced by uv radiation and chemical mutagens are reviewed. Different methods currently in use for isolating bacterial mutants are described and the precautions to be used in the methodology discussed. These methods can be used for isolating auxotrophic mutants, suppressor mutants, conditionally expressed mutants, and mutants resistant to analogues. Since uv light is absorbed efficiently by various constituents of complex media (such as purines, pyrimidines, and aromatic amino acids), the bacteria should be suspended in phosphate buffer before irradiation to obtain the best results. Samples are withdrawn after exposure to various doses of radiation and plated for survivors. The exposure time is so chosen for 0.1 to 1% survival. It is necessary to transfer each sample immediately after irradiation to a foil-wrapped flask to prevent photoreactivation. The small proportion of auxotrophs which arises by mutation either by uv or by a chemical mutagen is now isolated and, in the case of defective mutants, their specific nutritional requirements are identified. The isolation of auxotrophic mutants was greatly facilitated by the introduction of a method based on the mode of action of penicillin. Penicillin rapidly kills growing bacteria, but is innocuous to those which are not metabolizing. The wild types will be killed as soon as they begin to metabolize, but the auxotrophs, being unable to grow, will remain viable. As an example of the use of penicillin technique, the isolation of a methionine-requiring mutant of bacteria is considered. (BBB)

52051 GENETIC STUDIES OF STRAIN Bs8 OF ESCHERICHIA COLI. **Donch, John; Greenberg, Joseph (Palo Alto Medical Research Foundation, Calif.). Genet. Res., 12: 55-63(Aug. 1968).**

Strain Bs8 of E. coli, a uv-sensitive mutant of strain B, is unable to reactivate irradiated phage (HCR), cannot be induced by uv to form filaments, and is not as sensitive to thymineless death as strain B. Its uv sensitivity is the result of a mutation in a gene (uvr8) linked to gal. It differs from other HCR uv-sensitive mutants of strain B in its failure to form filaments after irradiation. It was shown that when uvr 8 was co-transduced with gal^+ into a gal lon K-12 derivative the transductants were significantly more sensitive to uv than Bs8 and were filament inducible. Nevertheless, strain Bs8 contains a lon gene which is transducible with $proC^+$ producing in a K-12 recipient a phenotype which is uv-sensitive, filament-inducible, and mucoid. When P1.Bs8 was used to transduced $proC^+$ into a proC K-12 strain, 4% of the transductants were lon, i.e., about as uv-sensitive as lon K-12, filament-inducible and mucoid. Radiation resistance could not be transduced from strain Bs8 with $proC^+$ into a proC lon K-12 derivative, nor did Bs8 show any evidence of being exr. Bs8 is a double mutant of strain B, behaving as though it were HCR in a B/r background. (BBB)

52052 INHIBITION OF MODIFICATION AND RESTRICTION FOR PHAGES λ AND T1 BY CO-INFECTING T3. Hirsch-Kauffmann, Monica; Sauerbrier, Walter (Univ. of Colorado, Denver). Mol. Gen. Genet., 102: 89-94(Aug. 5, 1968).

The host controlled modifications of phage λ-DNA by Escherichia coli B, K, and C(P1) can be suppressed by preinfecting the bacteria with uv-irradiated phage T3. Since uv-irradiated T3 induces an enzyme that cleaves S-adenosylmethionine into homoserine and thiomethyl adenosine, and since S-adenosylmethionine is the only methyl group donor for methylation, it was concluded that methylation was a required step in the host controlled modification of λ-DNA. T3 itself successfully infects E. coli K and B with its nonmethylated DNA. Also, restricted phage λ or T1 will be accepted by the restrictive hosts E. coli B, K, and C(P1) if these are preinfected with UV-T3. It thus appears that T3 is capable of blocking the restriction mechanisms in these hosts. The inability of T3 to grow on C(P1) is not understood. Since T3-DNA is restricted but not degraded into nucleotides by E. coli C(P1), it was presumed that degradation was not the initial step in restriction. (auth)

52053 THE MECHANISM OF ULTRAVIOLET INDUCTION IN LYSOGENIC STAPHYLOCOCCUS AUREUS. **Sompolinsky, D.; Yiflah, Yvonne; Aboud, M. (Bar-Ilan Univ., Ramat-Gan, Israel). J. Gen. Virol., 2: 347-56(May 1968).**

The significance of residual growth in the latent period after uv irradiation of a lysogenic strain (III) of Staphylococcus aureus was studied. It was shown that the organisms divide once or twice before the development of free phage and the number of infective centers are increased by about 100% in 30 min after irradiation. When celbenin, sodium 6-(2,6-dimethoxybenzamido)penicillinate, was added to the culture after irradiation, the number of infective centers decreased progressively, and no free phage developed. A delay of 10, 20, or 30 min in introduction of the drug allowed an increasing fraction of the infective centers to develop and to yield free phage. It was suggested that uv irradiation inhibits the synthesis of new repressor of vegetative phage development, but has no influence on repressor molecules present beforehand. Residual growth of the irradiated bacteria serves to dilute the intracellular repressor concentration below an effective level. (BBB)

52054 CHANGES IN THE SENSITIVITY TO ANTIBIOTICS OF SOME BACTERIAL STRAINS FOLLOWING EXPOSURE TO IONIZING RADIATION. Petrescu, Dorin; Arizan, Dan (Danielopolu Inst. for Normal and Pathologic Physiology, Bucharest). Rev. Roum. Physiol., 5: 141-6(1968).

Sensitivity to various antibiotics was studied in Streptococcus aureus, Escherichia coli, Proteus, and Candida after exposure to ^{60}Co γ radiation. Agar slant cultures, 9 hr old, of several strains isolated from patients, were irradiated with a single 400,000-R dose. When tested in broth, the suspensions prepared from the irradiated cultures showed, with a few exceptions, as compared to similar suspensions prepared from nonirradiated cultures, an increase (2 to 4000 times) of sensitivity to the bacteriostatic and bactericidal activity of penicillin, streptomycin, and chloromycetin. All 12 strains investigated were affected this way by irradiation, but the effect varied in intensity with the particular strain, antibiotic, and kind of effect (bacteriostatic or bactericidal). As a rule, irradiation acted on the microorganisms by modifying their susceptibility to the bacteriostatic rather than to the bactericidal activity of the 3 antibiotics tested. Irradiation increased the susceptibility to penicillin, streptomycin, and chloromycetin of the Oxford strain of Staphylococcus, and the yeast strain, initially resistant to these antibiotics developed a sensitivity which equalled and possibly surpassed that of the Oxford Staphylococcus strain. (BBB)

52055 ISOLATION AND CHARACTERISTICS OF A RECOMBINATION-DEFICIENT MUTANT OF ESCHERICHIA COLI. Erskine, J. M. (New Zealand Dairy Research Inst., Palmerston North). Aust. J. Sci., 31: 41-2(July 1968).

A method of isolating a recombination-deficient mutant of Escherichia coli is described. The procedure involved screening a gal⁻ strain of E. coli K12, treated with mutagen, for variants that could not incorporate and express the gal marker derived from the defective transducing phage, λdg. Survival of colony-forming ability as a function of uv dose was compared for two strains, as was their survival after x radiation. It was concluded that general radiation sensitivity is not a necessary consequence of impaired recombining ability. Models for recombination and repair of uv-damaged DNA were used to explain the observed correlation between defective recombining ability and extreme radiation sensitivity in the first rec⁻ mutants isolated. (H.L.W.)

52056 DARK REACTIVATION OF ULTRAVIOLET-IRRADIATED TOBACCO NECROSIS VIRUS. Kleczkowski, A. (Rothamsted Experimental Station, Harpenden, Eng.). J. Gen. Virol., 3: 19-24(July 1968).

Heretofore, the only kind of reactivation of uv-irradiated plant viruses known was photoreactivation. This paper reports the reactivation in darkness of uv-irradiated tobacco necrosis virus, which seems comparable to what is called host cell reactivation in uv-irradiated bacteriophages. Irradiation was performed with a low-pressure Hg lamp with a filter to eliminate wavelengths shorter than 2400 Å, so that most of the radiation was of wavelength 2537 Å. The virus at a concentration of 0.22 mg/ml was irradiated so that the intensity of irradiation was 0.86 mW/cm², i.e., 1.1×10^{-7} einstein/cm²min. Infectivity of uv-irradiated virus preparations was assayed by the local-lesion method using in each experiment 3 different species of host plant: tobacco (Nicotiana tabacum), French bean (Phaseolus vulgaris), and Chenopodium amaranticolor. Some damage caused in the virus by uv radiation could be repaired in darkness in Chenopodium (dark reactivation) but not in French bean or tobacco. By contrast, photoreactivation of the irradiated virus was observed in bean and tobacco but not in Chenopodium. The kind of damage in uv-irradiated virus susceptible to repair by photoreactivation appeared to be repaired by dark reactivation in Chenopodium. Under conditions yielding no evidence of repair, the quantum yield for inactivation of the nucleic acid inside the virus was about 6.5×10^{-4}, and the amount of radiation energy that must be absorbed by the nucleic acid to reduce infectivity to 50% was about 0.3 J/mg. (BBB)

52057 PHOTOREACTIVATION SPECTRA FOR PROPHAGE-INDUCING UV DAMAGE AND DELAYED APPEARANCE OF INDUCED PROPHAGE IN ESCHERICHIA COLI. Iwo, Kazuhiro (Osaka Univ.). Idengaku Zasshi, 43: 257-70(Aug. 1968).

The action spectra for photoreactivation (PR) of prophage-inducing lesions in two strains of Escherichia coli possessing and lacking PR enzyme activity are described. A quantitative analysis of the delayed appearance of prophage induction in uv-irradiated Bs-1 (80) cells was made. It was concluded that immunity lifting occurred in uv-irradiated Bs-1 (80) cells after the first post-uv cell division. Whether or not the filament forming character of Bs-1 (80) was responsible for the delayed immunity lifting was then investigated. A non-filament forming derivative was isolated from Bs-1 and its uv-response characters were primarily tested. A brief discussion is presented on the mechanism of delayed appearance of induced prophage in Bs-1 (80) and on its implication in kinetics of prophage induction in normal lysogenic strains. (B.S.L.)

52058 A MATHEMATICAL MODEL FOR CHLORELLA-CULTIVATION PARAMETERS UNDER CONDITIONS OF IONIZING IRRADIATION. Sakovich, I. S.; Smirnov, I. V.; Sakovich, V. A.; Vekshina, L. K. Kosm. Biol. Med., 1: 44-7(Nov.-Dec. 1967). (In Russian).

Mathematical models for studying the growth of Chlorella cells and biomasses under illumination available during a space flight in the presence of ionizing radiation are discussed. Formulas are derived to determine the ratio between the division rates and the growth rates of Chlorella cells as a function of the radiative energy supply. The validity of the results for continuous exposure of Chlorella suspensions to ionizing radiation is discussed. (IAA)

52059 SELECTIVE IRRADIATIONS OF BACTERIA BY MEANS OF T_2. Giacomello, Giordano; Grappelli, Adriana; Giovannozzi-Sermanni, Giovanni (Univ., Rome. CNR, Rome) Ric. Sci., 38: 389-95(Apr. 1968). (In Italian).

The effects of T_2 and THO on two microorganisms are described. The two microorganisms are Hydrogenomonas facilis and Bacillus macerans. The former is able to metabolize hydrogen and therefore tritium, the latter cannot. It was shown clearly that the radioactive compound, at low concentration in the medium, can be accumulated inside the cell, reaching a harmful concentration if the biochemistry of the cell allows it to metabolize the radioactive molecule, while the cells that do not utilize the radioactive compound do not show damage. The THO was used to control the radiosensitivity of two microorganisms. (auth)

52060 IONIZING RADIATION-INITIATED DEGRADATION OF DEOXYRIBONUCLEIC ACID IN BACTERIA. A POSSIBLE ROLE FOR DEFECTIVE PROPHAGE. Grady, Leo J.; Pollard, Ernest C. (Pennsylvania State Univ., University Park). Contracts AT(30-1)-2804; NsG-324. Radiat. Res., 36: 68-86(1968).

Data are summarized from experiments investigating a correlation between cellular capacity to synthesize macromolecules and the extent of deoxyribonucleic acid (DNA) degradation in bacteria exposed to γ radiation. It was shown that a relationship exists between conditions leading to an increase in degradation and those that would be expected to inhibit the induction of a prophage. Since the organisms used were known to harbor a defective prophage, additional experiments were carried out comparing under various conditions the response to ionizing radiation of Escherichia coli 15 T⁻ and a cured derivative. In addition, an effort was made to relate the presence of the defective prophage to colony-forming ability after irradiation. The results led to the hypothesis that the presence of the prophage results in less degradation than would otherwise be observed and may also be responsible for increased survival under certain conditions. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 51477, 51875, 51875, and 52042.

52061 (CONF-670945-) SEVENTH ANNUAL AEC FOOD IRRADIATION CONTRACTORS MEETING, SEPT. 27-28, 1967, WASHINGTON, D. C. (Division of Isotopes Development (AEC), Washington, D. C. Division of Biology and Medicine (AEC), Washington, D. C.). 243p. Dep. CFSTI.

SCHIZOMYCOTA — radiation effects on Achromobacter, Clostridium, and Pseudomonas, in seafood; Salmonella sp., radiation effects on culture characteristics and virulence of, γ; Clostridium botulinum, survey on Gulf Coast; Salmonella sp., radioinduced destruction of, in chicken meat; Clostridium botulinum, isolation of, methods for

FOOD IRRADIATION FACILITIES — performance of Portable Cesium Irradiator; dosimetry and standarization of AEC-supported; design for seafood; design and operation of commercial, for meats; construction of Hawaii Development Irradiator

MEATS — seafood, radiation processing of, determination of optimum dose for; seafood, radiation processing of, effects of, on nutrient value, organoleptic properties, and shelf life; poultry, radiation processing of chicken, effects of, on quality of proteins; radiation processing of, effects of, on color; chicken, radiation processing of, effects of, on population of microorganisms following inoculation

FRUITS — citrus, radiation processing of, effects of, on ascorbic acid content, juice yield, organoleptic properties, shelf life, and sugar content; radiation processing of apples, bananas, blueberries, cherries, mangoes, peaches, and strawberries; radiation processing of, dosimetry for γ
VEGETABLES — radiation processing of asparagus, mushrooms, carrots, and lettuce; radiation processing of, dosimetry for γ; potatoes, radiation effects on tuber development in, γ
GAMMA RADIATION — effects on enteroviruses, mutagenic
MYOGLOBIN — radiation effects on, γ
LIPIDS — radiation effects on stability of, in foods
TOXICITY — radioinduced, of seafood, effects of temperature on
PACKAGING — testing for storage of irradiated seafood
METABOLISM — radiation effects on, in carrots and lettuce
FOOD — radiation processing of, commercial prospects and cost analysis for
INSECTA — radiation effects on fertility and longevity of grain-infesting

52062 (JEN-189-SI/I-18) FOOD PRESERVATION BY IRRADIATION. VII. INVESTIGATIONS CARRIED OUT WITH TWO VARIETIES (ALAVA AND GINEKE) OF SPANISH POTATOES. Garcia de Mateos Lopez, A.; Rivas Garcia, A.; Ortin Sune, N.; del Val Cob, M. (Junta de Energia Nuclear, Madrid (Spain). Seccion de Isotopos). 1967. 22p. (In Spanish). Dep.

Radiation doses from 5 to 50 Krad were used and during a twelve month period the effects of γ radiation on the weight loss, sprouting and spoilage control, texture, ascorbic acid, and total carbohydrate content were studied. Tests of sprouting in field conditions are described. The dose of 8000 rads provided excellent control of sprouting regardless of variety. (auth)

52063 (ORNL-IIC-15) PRESERVATION OF BREAD BY MEANS OF GAMMA RADIATION. Stehlik, G.; Kaindl, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Biologie und Landwirtschaft). Translated by P. S. Baker (Oak Ridge National Lab., Tenn.), from report SGAE-BL-19/1967. 26p. Dep. CFSTI.

Experiments designed to extend the storage life of sliced bread using γ radiation alone and also combined with heat or chemical pretreatment are described. It was shown that by using combined methods to extend storage life to 8 to 10 weeks it was possible to apply doses that were already authorized in the USA for wheat and wheat flour. The organoleptic qualities of this bread were also investigated. No difference could be noted immediately after irradiation, even at a dose of 5×10^5 rad, when compared to the non-irradiated control sample. After storage of the irradiated sample for two months at room temperature, there was naturally a deterioration in quality in comparison to fresh bread; this, however, was due to the long storage period and not to the irradiation itself. The quality of the irradiated bread, in comparison to the canned sample, was slightly better. (auth)

52064 (STI/PUB-157) RADIOSTERILIZATION OF MEDICAL PRODUCTS. Proceedings Series. Proceedings of the Symposium held at Budapest, 5–9 June 1967 and Results of a Panel Meeting on Recommended Code of Practice held at Vienna, 5–9 December 1966. (International Atomic Energy Agency, Vienna (Austria)). 1967. 458p. (In Several Languages). (CONF-670644). IAEA: $9.50; Austrian Schillings 246,-; £3.7.0; F Fr. 46,70; DM 38,-.

Separate abstracts were prepared on 40 papers presented at this symposium. A recommended code of practice for the radiosterilization of medical products is included. (C.H.)

For abstracts of individual papers see: 51144, 52042, and 52068–52105.

52065 REFRIGERATION AND IRRADIATION OF VEGETABLES AND FRUIT. Staden, O. L. (Instituut voor Bewaring en Verwerking van Tuinbouwproducten, Wageningen, Netherlands). Conserva (The Hague), 15: 154-5(Dec. 1966). (In Dutch).

The combination of refrigeration and irradiation of foods involves a limiting lower temperature. Grapes and pears may be cooled to 0°C, apples to 4°C, tomatoes to 12°C, and cucumbers to 12.5°C. For apples these techniques are also combined with atmospheric control. Optimum conditions for various kinds of apples are being explored. Effective control of gloeosporium rot on Golden Delicious was not found. Spectacular lengthening of shelf life was found for cucumbers by combined irradiation and plastic wrapping, particularly with polyethylene. Improvement of strawberries was noted in conjunction with the insecticide eupareen applied in the growth period. Irradiation of mushrooms kept the heads closed on standing, though the taste spoiled just the same. Comments on sprout prevention in onions are also made; the Botrytis alii often found in onions can be destroyed without damaging the onion. (BBB)

52066 IRRADIATION OF FOODS, ESPECIALLY OF FRUITS AND VEGETABLES. de Zeeuw, D. Meded. Landbouwhogesch. Opzoekingssta. Staat Gent, 30: 657-66(1965). (In Dutch).

A review of recent developments in food irradiation is given. Irradiation of potatoes by the Canadian Atomic Energy Commission ^{60}Co source and in Russia is noted, along with commercial irradiation of fish, grain and meal products, and fruit (on the pilot-plant scale) in the U.S.A. is noted. A pilot plant project is anticipated for Holland this year; commercial planning is based on the American and Canadian limits for wheat, bacon, potatoes, and packaging material, as well as petitions for beginning processing of strawberries, tomatoes, cod, haddock, flounder, shrimp, lobster, mussels, onions, peaches, nectarines, pineapples, carrots, cherries, apples, and plums. Foods treated with low (4–40 krad) doses include potatoes, onions, and carrots; pasteurization doses (200–300 krad) are soft fruits, hard fruits, and some vegetables. The prolonged shelf time of irradiated foods is discussed in terms of market economy, as well as influence on the ripening process. (BBB)

52067 USE OF RADIATION FOR THE STERILIZATION OF PHARMACEUTICAL SOLUTIONS. Pandula, Egon. Honvedorvos, 19: 404-8(Oct.-Dec. 1967). (In Hungarian).

Different concentrations of atropine, ephedrine, glucose, hibernal, hydrocodone, lidocain, pilophene, relaxyl, tolazolin, Vitamin B_6, and Vitamin C solutions were irradiated with 2.5 Mrad of γ radiation. Changes in color, pH, active ingredient content, uv absorption, polarogram, and paper chromatogram were determined. Among the factors that influenced decomposition were the dose of radiation, concentration, and oxygen. Ascorbic acid, potassium pyrosulfite, and AET were used as protective compounds against decomposition after irradiation. In this manner, the rate of atropine decomposition was decreased from 39 to 4% and that of morphine from 18 to 6%. Sterility of the solutions was controlled by microbiological methods. (JPRS)

52068 REVIEW OF THE CODE OF PRACTICE FOR THE RADIOSTERILIZATION OF MEDICAL PRODUCTS. Kallings, L. O. (National Bacteriological Lab., Stockholm). pp 433-44 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The background of the IAEA recommendations for a Code of Practice for the radiosterilization of medical supplies and pharmaceuticals is outlined. The possibility of laying down broad safety margins based on scientific foresight and detailed advanced planning will serve to guide the rapidly accelerating acceptance of radiosterilization by industry, especially in those firms producing supplies for use in medicine and surgery. Production control should be attuned to the scientific and technological advances, and it is becoming clear that the focus of control should be moved away from sterility testing of the finished products to hygienic and sterile operations during the manufacturing operations themselves. The contamination of the product before sterilization should already have been kept to a minimum, and this pre-sterilization level of contamination should be regularly recorded using bacteriological tests. The choice of radiation dosage should be based on average pre-sterilization bacteria counts and the inactivation factors found desirable for the intended use of the product. On commissioning, or whenever an existing process is altered, the efficiency of the irradiation facility must be tested using microbiological reference standards. The margin of safety should be checked by using deliberately contaminated articles. However, the backbone of the control procedures must still be dosimetry. The preparation of a Code of Practice for the radiosterilization of medical products will constitute a challenge to operators working with other sterilizing procedures. (auth)

52069 CODE OF PRACTICE FOR RADIOSTERILIZATION OF MEDICAL PRODUCTS. pp 423-31 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

In common with other methods of sterilization, the efficiency of radiation sterilization of medical supplies and pharmaceuticals is dependent upon the numbers and types of contaminating organisms present and also upon the environmental conditions in which they occur. The choice of radiation dose is determined by the microbiological standards achieved and by the degree of control that can be exerted upon the pre-sterilization contamination of the products concerned. Microbiological control procedures are discussed. A Code of Practice for the radiosterilization of medical supplies and pharmaceuticals, recommended by the International Atomic Energy Agency, is presented. (C.H.)

52070 A PRODUCTION GAMMA IRRADIATION PLANT FOR RADIATION INVESTIGATIONS. Zhukov, B. G.; Kaushanskii, D. A.; Mikheenkov, A. F. (State Atomic Energy Committee, Moscow). pp 407-14 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In Russian).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The development of typical γ irradiation plants for biological, medical, radiation chemistry, and agricultural studies is discussed. The principal demands made on pilot industrial and experimental irradiation plants are given. Various experimental plants have been developed in the USSR, and the technical data of some of them are described. (auth)

52071 THE RELATION OF DESIGN PARAMETERS, PLANT CAPACITY AND PROCESSING COSTS IN ^{60}Co STERILIZATION PLANTS. Brown, M. G. (Atomic Energy of Canada Ltd., Ottawa). pp 381-94 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The main features of three basic types of ^{60}Co γ irradiation facilities that were designed to provide a complete range of capacities for the radiosterilization of medical products are described. The smallest plant has a capacity of up to 50,000 cubic feet of medical products a year, the intermediate size plant has a capacity of up to 500,000 cubic feet a year, and the largest plant has a capacity in excess of 1,000,000 cubic feet a year. The relations between capital costs, rate of production, efficiency, and unit processing costs for each type of plant are discussed. The method of selecting the best type of plant for a particular need is outlined. (auth)

52072 RELATION OF PLANT DESIGN TO PRODUCT COST. Baines, B. D. (Nuclear Chemical Plant Ltd., London). pp 395-405 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The cost of medical supplies varies enormously, from a few cents per unit to a figure many times this. In the latter case the capital cost of medical supplies held up in the irradiation cell can vary considerably and may be of the order of $100,000 or more. To reduce the cost of capital invested in the irradiation plant and the stock of product in the plant requires a special design approach resulting in a plant design that is unusual. The γ irradiation facility employed by ETHICON Limited in Edinburgh, Scotland is described. (auth)

52073 OPERATION OF AN IRRADIATION CENTRE SPECIALIZING IN THE STERILIZATION OF MEDICAL AND SURGICAL SUPPLIES. Icre, P.; Petit, F. (Societe de Recherches Techniques et Industrielles, Boulogne, France). pp 367-79 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In French).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

CARIC (Center for the application of ionizing radiations, Corbeville, France) is equipped with a CIRCE 10 CSF linear electron accelerator, whose essential characteristics are: an energy of 7 MeV, which allows treatment of packages from 10 to 40 cm thick, depending on the density and the conditioning of the products; a power of 10 kW, corresponding to a theoretical capacity of 3.6 t/h at 1 Mrad. The center consists of an irradiation unit, a control room, a handling area, and ancillary facilities. A requirement for the radiosterilization of a given material is the determination of the technical conditions of treatment, i.e., energy and rate of passage. These factors are determined by calorimetric or PVC dosimetry. The treatment may involve single or double irradiation, depending on the product. The exploitation yield rarely exceeds 60%. Applications for the sterilization of packaged medical supplies and pharmaceuticals are discussed. (auth) (TSS)

52074 DEVELOPMENT OF INDUSTRIAL STERILIZATION OF MEDICAL PRODUCTS. Jefferson, S. (United Kingdom Atomic Energy Authority, Wantage, Eng.); Crawford, C. G. pp 361-5 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Ionizing radiation is well established on a worldwide basis as being suitable for sterilization of medical products. The penetrating nature of the radiation and the negligible temperature rise resulting from the process make it suitable for pre-packaged equipment. The hermetic sealing of individual items ensures a long shelf life. Most experience has been gained with plastic equipment and only a few drugs have so far been considered suitable for radiation sterilization. The basic features of a γ irradiation facility for medical supplies and pharmaceuticals are discussed and the effect of type of installation and the magnitude of the throughput on the cost of the process are outlined. (auth)

52075 STERILITY STUDY OF ^{131}I-LABELLED PREPARATIONS DESIGNED FOR HUMAN DIAGNOSTICS. Igali, S. (Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 355-8 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Because of the relatively long incubation period, no classical sterility tests can be applied for preparations containing radionuclides with short half-lives. An initial sterility testing of the working sites and materials used, completed by the quick testing of the end-product, might be used instead. The efficiency of the method is demonstrated by experiments performed with ^{131}I-albumin and ^{131}I-hippuran. Data are published on the time-dependent decline of colony-forming centers in radioactive products. (auth)

52076 THE SURVIVAL AND RECOVERY OF IRRADIATED BACTERIAL SPORES AS AFFECTED BY POPULATION DENSITY AND SOME EXTERNAL FACTORS. Farkas, J.; Kiss, I.; Andrassy, E. (Central Food Research Inst., Budapest). pp 343-54 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The destruction of spore-forming bacteria is one important aim of sterilization treatments. The dose required for radiation sterilization is determined mainly by the number and the radiation resistance of the bacterial spores present. The x radiation resistance of Bacillus cereus spores as affected by the pH-value and cell density of the irradiated spore suspensions was investigated. The portions of the survival curves of suspensions of 10^8, 4×10^3, and 5×10^1 per milliliter viable cell counts, respectively, were compared for a three-orders-of-magnitude decrease in viable cell count. It was established that the initial cell density did not affect radiation resistance of spores. Radiation resistance as affected by pH-value in the range of 3 to 8 was investigated. In the range of pH 5 to 8, the radiation resistance of B. cereus spores was not affected. By lowering the pH-value to below 5, the radiation resistance decreased below that observed in the neutral region. The colony-forming capacity of B. cereus, B. coagulans, and B. pumilus as a function of the pH-value in the nutrient medium, and the pH-sensitivity of bacterial spores as affected by radiation, were also investigated. It was established that irradiation increased the pH-sensitivity of surviving bacterial spores in all three strains. The initial phase of spore germination (the phase accompanied by decrease of refractivity of the spores) and the division stage of vegetative cells proved to be the most sensitive to the value of the hydrogen ion concentration. (auth) (TSS)

52077 SURVIVAL OF THE VEGETATIVE AND SPORE FORMS OF BACTERIA IRRADIATED IN PHARMACEUTICAL POWDERS. Igali, S. (Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 339-41 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The γ radiosensitivity of both vegetative and spore forms of bacteria in pharmaceutical powders was studied as a function of the dose delivered. A method was developed for performing sterility tests. The radiation resistance of dried Escherichia coli irradiated in thyreoidea powder increased two or three fold. The results for the colony building ability of the irradiated bacteria varied with the experimental methods and conditions used. On the basis of the results it is clear that the sterilizing dose has to be worked out for each particular product since the radiation resistance of bacteria varies with the specific conditions of preparation and the physical and biological factors. (auth)

52078 A COMPARATIVE STUDY OF ETHYLENE OXIDE AND RADIATION STERILIZATION OF MEDICAL DEVICES. Brewer, J. H.; Keller, G. H. (Becton, Dickinson and Co., Rutherford, N. J.). pp 311-37 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Both radiation and gas sterilization have been widely accepted for the cold sterilization of disposable medical supplies. Each of these methods offers certain advantages over the other but

has characteristics which make it less satisfactory for specific items. This study is especially concerned with the effectiveness of various dosage levels and of electrons and γ radiation and gassing cycles on known concentrations of test organisms, as well as similar studies on routine production lots on which pre-sterilization counts were made. The experimental methods employ techniques which were developed for the National Aeronautics and Space Administration Planetary Quarantine Program and are now standard procedures for the sterilization and microbiological examination of space equipment. The results are much more meaningful than those obtained with techniques employed earlier. Good manufacturing practice and plant hygiene are essential for the practical application of both these sterilization methods in order that chosen dosage levels and cycles will ensure a factor of safety. Manufacturing methods to ensure a low microbiological count are described. Data are presented on the effect of composition of materials on retention and survival of contaminants and die-off of contaminants on handled materials and components before sterilization. Factors concerning the cost-effectiveness of the two methods and other engineering values are discussed. (auth)

52079 PRE-STERILIZATION BACTERIAL CONTAMINATION ON DISPOSABLE HYPODERMIC SYRINGES: NECESSARY INFORMATION FOR THE RATIONAL CHOICE OF DOSE FOR RADIATION STERILIZATION. Cook, A. M. (Univ. of London); Berry, R. J. pp 295-308 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The numbers and types of microorganisms contaminating disposable plastic hypodermic syringes were assessed prior to sterilization. A large number of syringes was taken at random from the production lines of three independent manufacturers. The microbiological investigations were carried out in the laboratories maintained by each of these manufacturers for routine sterility testing, according to a standard protocol devised by the Research Committee of the UK Panel on Gamma and Electron Irradiation, which co-ordinated the investigation and analysed the results. Items produced by any one manufacturer were assessed for microbial contamination both in their own laboratories and in the laboratories of the other manufacturers. The level of false positive results was determined independently for each laboratory by the testing of known sterile items which had been subjected to the radiation sterilization process. Both the percentage of syringes initially sterile, and the average number of organisms per contaminated syringe differed among the three manufacturers. When corrected for differences between the assessments by the various laboratories, the ranges observed were 16 to 48% initially sterile, and 20 to 70 organisms per contaminated syringe. Of 964 syringes tested by all three laboratories, only one contained over 1000 aerobic organisms (1133). The most common organisms found on the 62 more heavily contaminated syringes (100 to 1000 organisms) were coagulase-negative Gram-positive cocci. Two manufacturers assessed contamination by anaerobic organisms; on 610 syringes, one contained 4275 organisms, three more had 100 to 1000 organisms, but 488 (80%) were uncontaminated by anaerobes. The results are discussed in the context of the choice of radiation dose necessary for the sterilization of medical products manufactured under controlled hygienic conditions. (auth)

52080 GAMMA-RAY STERILIZATION OF STARR-EDWARDS HEART VALVE PROSTHESES. Gibbons, J. R. P.; Alladine, M. F. (London Chest Hospital, Eng.). pp 289-94 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Starr-Edwards valves have normally been sterilized by exposure to ethylene oxide or by autoclaving. Patients having a prosthetic heart valve replacement are known to have a higher incidence of endocarditis in comparison with patients in which no prosthesis has been used. Ethylene oxide will only sterilize the surface of the valve and autoclaving has caused distortion of the polytetrafluorethylene ring. Work has been done on the effect of γ radiation on the components of these valve prostheses and is given in detail. The bacteriological efficiency, at a total absorbed dose of 2.5 Mrad, has been established. Thirty valves treated by this method have now been inserted and twelve patients have been examined post-operatively for a period of one to two years. All valves are working normally, and there has been no evidence of blood-borne infection or malfunction of the valve. (auth)

52081 THE USE OF TYGON TUBING STERILIZED BY GAMMA RADIATION IN HEART-LUNG BY-PASS MACHINES. Alladine, M. F.; Gibbons, J. R. P. (London Chest Hospital, Eng.). pp 285-8 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Tygon tubing is a co-polymer polyvinyl chloride. This tubing is used throughout the circuit of the heart-lung by-pass machines and has been sterilized by autoclaving or exposure to ethylene oxide gas. Tubing sterilized by autoclaving was noted to have a decrease in tensile strength and the transparency of the tubing was affected. Sterilization by ethylene oxide had the disadvantage that gas was often present in the lumen of the tube when connected to the machine. Lengths of Tygon tubing were sterilized by γ radiation at varying radiation levels and temperatures. Bacteriological studies were done on the tubing and estimation of tensile strength carried out. A level of radiation of 2.5 to 3.0 Mrad at 20°C produced little or no change in tensile strength and the tubing remained bacteriologically sterile. Tygon tubing sterilized in this way has now been used in over sixty heart-lung by-pass machine operations. (auth)

52082 RADIOSTERILIZATION OF MEDICAL DEVICES AND SUPPLIES. Christensen, E. A. (Statens Seruminstitut, Copenhagen); Holm, N. W.; Juul, F. A. pp 265-83 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

A description is given of methods used for the γ radiosterilization of medical devices and supplies. Special attention is given to the problem of establishing the best criteria for a sound judgement of the process from a microbiological point of view, and for an accurate and dependable process control in the form of radiation dosimetry. A list of typical products is given, and the development and commercialization of the process in Denmark are described. (auth)

52083 COMPARATIVE RADIOSENSITIVITY OF PATHOGENIC BACTERIA AND VIRUSES. Ghys, R.; Vandergoten, R.; Paquette, J.-C.; Fredette, V.; Plante, C.; Pavilanis, V.; Gilker, J.-C. (Univ. of Montreal). pp 243-61 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In French).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Pathogenic bacteria and viruses were exposed to γ rays from a ^{60}Co source. The organisms included a slow-growing aerobic bacterium (Mycobacterium tuberculosis, 10 varieties of the strain B.C.G.), a fast-growing bacterium (Clostridium perfringens, strain SWG-121) and 4 strains of influenza virus (2 from group A and 2 from group B). In the case of B.C.G., an LD_{90} of 29 ± 1 kR is reported for bacilli irradiated immediately before subculture and subsequently cultivated for 28 days, the yield from cultures after exposures of up to 50 kR was at least equal to that of control specimens; it then decreased rapidly, and a dose of 140 kR inhibited bacterial growth completely. The LD_{90} of the strain of C. perfringens used in the study was very much dependent on the culture conditions and the conditions under which the microbe growth measurements were made; 24 hr after irradiation it was at least 1 MR. Although no spores were seen in the microscope, this would seem to demonstrate the presence in the cultures of extremely radioresistant sporulated individuals. Group A influenza viruses were found to be more radioresistant than those of group B. The LD_{90} of relatively low radiation doses varied between 75 and 100 kR, and was higher if irradiation was performed at −78.5°C. It was very difficult to inactivate the last virus particles; multiplicity reactivation seemed to occur in certain experimental conditions. Hemagglutinant activity did not vary, even after the highest exposures used (4 MR). Two important practical conclusions are drawn: The use of a single dose (e.g., 2.5 Mrad) for radiosterilization gives an exposure which is unnecessarily high in some cases and insufficient in others, and selective radiosterilization is sometimes possible. The viability of a microorganism used, for example, to produce a vaccine may not be seriously affected by an exposure which completely destroys a possible contaminant. (auth)

52084 USE OF IONIZING RADIATIONS TO PREPARE RADIOVACCINES AND RADIO-ANTIGENS. Tumanyan, M. A.; Khrushchev, V. G. (Gamaleya Inst. for Epidemiology and Microbiology, Moscow). pp 231-41 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In Russian).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The possibility of employing ionizing radiations at certain doses to kill microorganisms to produce vaccines against intestinal

infections, and also to obtain from these bacteria antigens capable of being used as chemical vaccines is discussed. Typhoid fever and dysentery vaccines and antigens were prepared, and the effect of various γ ray doses on their toxicity and their antigenic and immunogenic properties was tested. The doses used did not change properties of these products as compared with those of vaccines and antigens produced by normal means. The possibility of using radiation to sterilize fabricated vaccines, antigens, anitoxins, antitoxic serums, and nutrient media for the culture of microorganisms is discussed. Data on the irradiation apparatus used for these investigations are reported. (auth)

52085 GENERAL PRINCIPLES INVOLVED IN THE USE OF IRRADIATED LARVAL VACCINES. Miller, T. A. (Univ. of Glasgow Veterinary Hospital). pp 219-30 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The effect of ionizing radiations on helminth parasites has been under investigation now for about half a century, but only in the last 15 years has extensive and intensive work been conducted. The results have shown that in numerous host-parasite systems, ionizing radiation has attenuated or partially inactivated the parasite and that infection of host animals with irradiated larvae has stimulated immunity without accompanying disease. The immunity of vaccinated animals has subsequently been challenged by infection with normal larvae and, while unvaccinated control animals have suffered severely from the resultant disease and have often died, vaccinated animals survived the challenge of immunity usually without significant signs of disease. Comparison of the worm burdens from challenge infections in vaccinated and in control animals have further confirmed the protective effect of prior vaccination with irradiated larvae. In addition to economically important helminth diseases, various host-parasite relationships in laboratory animals have been investigated and the immunogenic efficacy of x-irradiated vaccines has been further demonstrated. There are at present two irradiated vaccines in commercial use in veterinary practice and their value has been unequivocally proven. It is probable that within the next few years at least one additional irradiated vaccine will be in use in veterinary practice. Some of the concepts and principles involved in the preparation, use, and possible method of action of irradiated vaccines, with particular reference to a vaccine for hookworm disease of dogs, are described. (auth)

52086 PREPARATION AND TESTING OF RADIOVACCINES. Bonet-Maury, P. (Institut du Radium, Paris); Olivier, H. R.; Gallut, J.; Lepine, P.; Mollaret, H.; Servant, P. pp 209-18 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In French).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The effect of ionizing radiations on viruses and bacteria differs from that of the physical or chemical bactericides used in vaccine production in that it leads to dissociation of the cellular functions. This appears to be a general property of ionizing radiations, since it has been found to occur with many different types of radiations, including α particles, x rays, γ rays, neutrons, boron fission rays, and protons. It is therefore hoped that radiosterilization will result in a permanent inhibition of the virulence of pathogenic germs while affecting to a lesser degree their antigenic properties, and that vaccines of valuable immunizing power can be produced. The absorbed doses of various ionizing radiations (α particles, neutrons, boron fission rays, and ^{60}Co γ rays) that completely suppress virulence were determined for a number of viruses (aphthous fever, poliomyelitis) and bacteria (Escherichia coli, Koch, Yersin, Mallassez, and Vignal bacillae, Vibrio cholerae and Salmonella typhi). The antigenic properties and immunizing power of these vaccines are compared with those of heat-sterilized vaccines of the same germs. (auth)

52087 RADIOSTERILIZATION OF MEDICAL SUPPLIES. Tumanyan, M. A. (Gamaleya Inst. for Epidemiology and Microbiology, Moscow). pp 199-207 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In Russian).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Information is given on the γ radiation sterilization of medical supplies and on the possible occurrence of radioresistant non-spore-forming bacterial mutants as a result of multiple irradiation. (auth)

52088 STERILIZATION OF CATGUT BY IONIZING RADIATION. Molnar, I.; Meszaros, G.; Nagy, L.; Szita, J.; Lengyel, S. J. (Textile Research Inst., Budapest). pp 187-95 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The background of sterilization of catgut by presently accepted methods and by means of ionizing radiation is briefly reviewed. After irradiation experiments, comparisons were made on tensile strength, absorption swelling, shrinking, and sterility of catgut sterilized by the classical methods, by electrons from a Van de Graaff generator, and by γ rays emitted by a ^{60}Co source. Sterilization by γ rays was found to be superior to other methods. Reliable sterility was obtained with a dose of 3.5 Mrad. (auth)

52089 GAMMA-RAY STERILIZATION OF HOMOGRAFT AORTIC VALVES. Gibbons, J. R. P.; Alladine, M. F. (London Chest Hospital, Eng.). pp 181-6 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Homograft replacement of the aortic and pulmonary valves is a well-established procedure. A simple and reliable method is required in the preparation, sterilization, and storage of these valves. A study was made on the effects of γ radiation of homograft valves at varying radiation levels and temperatures. Valve cusps and aortic wall were irradiated and then examined using normal histological techniques and electron microscopy. Bacteriological studies were done for 2.5 Mrad dose. No positive cultures were obtained from 64 strips from the aorta taken at the time of dissection of the same number of homograft valves. A satisfactory level of radiation was found where valves are bacteriologically sterile with little or no alteration in structure or change in the physical characteristics of the homograft valve. Ten valves were inserted into patients, replacing diseased aortic valves, and are working satisfactorily. The first two patients were followed in the clinic for six months following operation and are known to be in good health. These valves are working satisfactorily. (auth)

52090 DESTRUCTION OF RADIATION-RESISTANT MICROORGANISMS ON SURGICAL SUTURES BY ^{60}Co IRRADIATION UNDER MANUFACTURING CONDITIONS. Van Winkle, W. Jr.; Borick, P. M.; Fogarty, M. (Ethicon, Inc., Somerville, N. J.). pp 169-80 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Any process adopted for producing sterile medical products must be demonstrated to produce sterility under reproducible manufacturing conditions. In addition, a margin of safety is required to guard against non-sterility due to undetected departures from standard operating practices. This study reports the results of exposure to ^{60}Co γ rays of surgical sutures intentionally contaminated with known radiation-resistant organisms, including St. faecalis, M. radiodurans, and B. pumilus, under normal manufacturing conditions. The results of over 20,000 sterility tests under prolonged incubation are also reported to indicate that routine sterility testing of radiation-sterilized sutures is adequate to detect radiation survivors. The nature and level of the natural contaminants of surgical sutures before sterilization is tabulated and discussed from the standpoint of the safety factor inherent in the process. (auth)

52091 THE INFLUENCE OF TISSUE LYOPHILIZATION AND GAMMA IRRADIATION ON THE SOLUBILITY OF PROTEINS. Komender, J.; Jendyk, J.; Leibschang, J. (School of Medicine, Warsaw). pp 163-8 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Most recent methods of tissue preservation are based on lyophilization and sterilization with γ rays. Unfortunately the tissues preserved by this method lose their viability, this being connected with protein denaturation. The denaturing influence either of lyophilization or sterilization with γ rays on different materials has been described. However, no observations on denaturation of proteins in prepared grafts are known. Results are reported from studies on the influence of individual stages of the procedure used in a tissue bank on the solubility of proteins. An experiment was performed using rat liver as a model tissue. Solubility of protein was determined in five groups of material, as follows: fresh tissue, used as a control; frozen tissue; frozen and lyophilized tissue; frozen, lyophilized, and irradiated tissue; and fresh irradiated tissue. Folin's method was used for determination of protein in water extracts of tissues. It was found that the whole procedure considerably diminished the protein solubility, freezing diminished the protein solubility by 35% on average, lyophilization causes no further protein denaturation, and protein

solubility was reduced most (by about 65%) by sterilization with γ rays. (auth)

52092 THE INFLUENCE OF IONIZING RADIATION ON VARIOUS COLLAGEN-CONTAINING MEDICAL BIOPRODUCTS. Schnell, J.; Plenio, H. G.; Pauli, W.; Braun, B.; Korb, G. (Medical-Pharmaceutical Works, Melsungen, Ger. Max-Planck-Institut fuer Eiweiss- und Lederforschung, Munich). pp 145-61 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Dose-dependent alterations in irradiated catgut sutures, processed animal bones, and purified dura mater transplants are discussed in terms of damage to the product which might influence its practical use. A comparison between untreated and γ- or electron-irradiated catgut was made. The shrinkage temperature (T_S) was lowered as the radiation dose increased; a marked difference between γ and electron irradiation was observed: after electron irradiation at 2.5, 5, and 10 Mrad the T_S values were from 3 to 6°C lower than after γ irradiation at corresponding doses. The knot tensile strength was influenced in the same manner; 2.5 Mrad caused up to 8% and up to 15% reduction after γ and electron irradiation, respectively, while at 10 Mrad the corresponding values were 20% and 65%. Extraction of thermally denatured sutures under different pH-value conditions yielded increasing proportions of extractable collagen material when the irradiation dose was raised. In vitro digestion tests, carried out both with pepsin and trypsin, showed a much more rapid degradation occurring after electron irradiation. Processed animal bone (Kiel bone) contained about 21% collagen; this protein could partly be extracted, the amount depending on the radiation dose. Human dura mater that was sterilized at 2.5 and 5 Mrad exhibited some extent of molecular breakdown, as expressed in terms of T_S, tensile strength, solubility, and enzymatic degradation. Histological examinations of subcutaneously implanted dura samples are discussed. (auth)

52093 RADIOSTERILIZATION OF TISSUES PRESERVED FOR CLINICAL PURPOSES: EFFECT ON TISSUE AND ANTIGENICITY. Ostrowski, K.; Kossowska, B.; Moskalewski, S.; Komender, A.; Kurnatowski, W. (School of Medicine, Warsaw). pp 139-43 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Practical considerations on the radiosterilization of preserved human bone, human and calf cartilage, cow's fascia and aponeurosis are discussed based on material from a tissue bank which produces about 2500 transplants yearly. The method of preservation and packing of each type of tissue is mentioned briefly. The preserved tissues are irradiated in a ^{60}Co bomb or in a nuclear reactor. The conditions of irradiation and the control of sterility are described. The advantages and disadvantages of radiosterilization are discussed on the basis of experience and clinical reports of surgeons using radiosterilized tissues in practice. Results of experimental studies on the influence of freezing, lyophilization, and radiosterilization on tissue antigenicity are reported. The regional lymph node reacts to an antigenic stimulus by an increased production of large, pyroninophylic cells, or so-called blast cells. The rabbits used as recipients received grafts of allogeneic cancellous bone, fresh or subjected to different experimental procedures. Smears from lymph node cell suspension were prepared and the percentage of blast cells was estimated. On the basis of the lymph node response, it appeared that freezing and lyophilization, as well as radiosterilization, may abolish the antigenicity of cancellous bone. The practical implication of these results for methods of preservation of tissues for clinical purposes is discussed. (auth)

52094 STERILIZATION OF NORMAL HUMAN PLASMA AND SOME OF ITS FRACTIONS BY MEANS OF GAMMA RAYS. Lopez Martinez de Alva, L.; Crespo Cortina, M. (Comision Nacional de Energia Nuclear, Mexico City). pp 125-35 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In Spanish).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Owing to the frequency with which normal human plasma transmits hepatitis, various methods of sterilization have been tried. The method most used, but which has been shown to be ineffective, is sterilization of the liquid plasma with uv rays. The other method is the use of β-propiolactone, but this has also been discontinued because of the changes it produces in the structure of plasma proteins. The object of the present study, which should be regarded as a preliminary report, is to present the results obtained by sterilizing, by means of γ rays (^{60}Co, 1.3316 MeV) at doses of 2, 2.5, and 3 Mrad, a substance which, like plasma, contains highly labile proteins easily able to undergo structural changes under irradiation. Pure fibrinogen, pure gamma globulin, and albumin of human origin were subjected to the same doses; the results were very satisfactory, in that no appreciable change could be demonstrated as regards the structure, solubility, or chemical characteristics of the substances concerned. It was shown by means of simple coagulation tests that some of the proteins involved in this mechanism, such as prothrombin, the Power-Stuart factor, and the Hageman factor, were practically unchanged. All the plasma samples and the various proteins were previously lyophilized to give a maximum moisture content of 0.034%, in order to avoid ionizing the water content into oxygenated water, which would modify and oxidize the proteins. It was shown that lyophilized plasmas initially contaminated with different strains of bacteria and viruses remained sterile with doses as low as 2 Mrad. It was also shown that this method is simple and practical, since sterilization can be checked in the final packaging. (auth)

52095 STUDIES OF GAMMA-RAY-IRRADIATED HUMAN IMMUNOGLOBULIN G. Gergely, J.; Medgyesi, G. A.; Igali, A. (National Blood Service, Budapest). pp 115-24 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Freeze-dried human immunoglobulin G (IgG) with incomplete anti-Rh_0(D) activity retained its reactivity after irradiation with a dose of 1.5–2.5 Mrad γ rays. A portion of the irradiated protein was insoluble. Gel-filtration on Sephadex G-200 indicated the presence of aggregated IgG in addition to the non-aggregated form. Proteolytic experiments revealed an altered digestibility of the protein with papain after irradiation. (auth)

52096 THE EFFECT OF ^{60}Co GAMMA IRRADIATION ON VARIOUS FRACTIONS OF HUMAN BLOOD-PLASMA PROTEINS. Antoni, F.; Panigl, W.; Schwarz, O.; Simonich, W.; Kozinets, G.; Schulman, M.; Arky, J. (International Atomic Energy Agency, Vienna). pp 107-14 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The potential usefulness of employing ionizing radiation to cold-sterilize biomedical products has stimulated interest in characterizing the radiation sensitivity of various biologicals like vitamins, antibiotics, enzymes, antibodies, and blood plasma fractions. Findings are presented on the sensitivity of hemagglutinin activity in human blood sera exposed to ^{60}Co γ radiation. At doses tested between 0.2 and 5.0 Mrad, α-isohemagglutinins were found to be more readily inactivated than β-isohemagglutinins, but neither was completely inactivated in this range. Sterility, clotting, and antihemophilic activity were also assessed on irradiated and freeze-dried preparations of human plasma with no significant differences in response detected. (auth)

52097 EXPERIMENTAL EXPOSURE TO GAMMA RADIATION OF SMALL MEDICAL ARTICLES AND PHARMACEUTICAL PROTEIN SOLUTIONS. de Saint-Aubert, G.; Valette, L. R.; Plan, R.; Cherby, D. (Institut Merieux, Lyon). pp 97-105 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In French).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The behavior under exposure to γ rays of small medical articles (multipuncture rings and self-injecting plastic ampule-syringes) and protein solutions (purified anti-tetanus serum and polyvalent gamma globulins in glass phials) was studied with a view to considering the applicability of radiosterilization techniques to such articles and solutions. The radiation source used was an assembly of ^{60}Co rods with a total activity of 41,600 Ci (1.65 Mrad/hr). The articles were exposed to a fixed dose of 3.3 Mrad. Various batches of solutions were exposed to doses ranging from 0.5 to 3.3 Mrad. The irradiated articles were physically checked for sterility in culture media and also for harmful effects on small animals. Physical checks were carried out on the protein solutions for sterility in culture media, activity in small animals, and by serum neutralization, and physico-chemical checks were also performed by immuno-electrophoresis and electrophoresis. The results of these different checks, which showed that the protein solutions were extremely unstable, were studied with a view to assessing the possibility of exposing these medical articles and pharmaceutical solutions to sterilizing doses of γ radiation. (auth)

52098 RADIATION STERILIZATION OF THYROID. Hangay, G.; Hortobagyi, G.; Reday, Z.; Zarandy, A. (Chemical Works of Gideon Richter Ltd., Budapest). pp 91-6 of Radio-

sterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

With the application of radiation sterilization in the pharmaceutical industry, attention should be paid to the possibilities of sterilizing biological products, of which thyroid is one example. The opinion that thyroid tissues can be satisfactorily sterilized by irradiation is based on the physico-chemical and the bacteriological examinations. The samples were γ irradiated at various doses, and their effects were determined by several physical and chemical tests. Radiation appeared to inactivate thyroid under certain conditions. However, a 2.0 Mrad dose did not cause any change in the biological activity of the material examined. A bacterial count of 100 gm can be achieved with doses (1.3 to 1.8 Mrad) below the maximum tolerance, even with highly contaminated batches. (auth)

52099 EFFECTS OF RADIOSTERILIZATION ON SEALED AQUEOUS SOLUTIONS. Pandula, E. L.; Farkas, E.; Racz, I. (Inst. of Pharmaceuticals, Budapest). pp 83-9 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

For aqueous solutions sensitive to heat, and in connection with the use of plastic ampules, the need for applying radiosterilization is growing. Studying the possibilities of radiosterilization, experiments were made with the following: 0.1% atropine, 1.0% morphine, and 2% lidocaine in aqueous solutions. The work was designed to establish whether the active ingredients of the injections suffer decomposition or not, to study the factors influencing the degradation, and to make attempts to prevent decomposition. The samples were irradiated by 420 Ci ^{60}Co γ radiation source. The applied doses were 1 to 2.5 Mrad, with a 10^4 to 2.5×10^5 rad/hr dose intensity. After irradiation the change in color, pH value, concentration, and uv spectra were studied. Changes of the last three types were found. Studying the factors influencing decomposition it was found that the degree of degradation was increased by the increase of radiation dose, increase of concentration, decrease of dose intensity, and increase of oxygen content in the atmosphere over the solution. Attempts were made to prevent degradation. Solutions were prepared with sulfite, ascorbic acid, and AET, and some measure of success was achieved, especially with the addition of sulfite. (auth)

52100 STERILIZATION OF HYDROCORTISONE EYE-OINTMENT BY γ IRRADIATION. I. PHYSICAL AND CHEMICAL ASPECTS. Hangay, G.; Hortobagyi, G.; Muranyi, G. (Chemical Works of Gideon Richter Ltd., Budapest). pp 55-62 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

Many eye ointments cannot be sterilized by traditional methods. For this reason, a study on the application of radiosterilization would appear to be justified. Details are presented of chemical and physical tests applied to γ irradiated samples of both a hydrocortisone eye ointment and its various components taken individually. The tests included changes of appearance and volume, measurements of physical properties (e.g., melting and slipping points, density, viscosity, ductility, etc.), pH-measurements, plots of uv-absorption curves, IR-spectrophotometry, etc. The conclusions suggest that radiation sterilization could be accepted for this ointment from the physical and chemical points of view. (auth)

52101 STERILIZATION OF HYDROCORTISONE EYE-OINTMENT BY γ IRRADIATION. II. BACTERIOLOGICAL ASPECTS. Haraszti, Maria (State Inst. of Hygiene, Budapest); Czeh, K.; Hangay, G. pp 63-8 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

The effectiveness of the sterilization of opththalmic ointments by γ irradiation was checked by bacteriological examinations. For the experiments B. pumilus was found to be most suitable of the test strains which have been investigated so far. The resistance of the spores of this organism to irradiation was determined. Subsequently opthalmic ointment samples were artificially contaminated with spore suspensions of the test organism, containing known spore counts. The samples were subjected to different doses of irradiation, and recovery examinations were made. A marked increase in the resistance of the spores due to the ointment medium could be observed. The experiments show that guaranteed sterility is not achieved even with doses as high as 5.0 Mrad if massive contamination is present. (auth)

52102 EFFECT OF GAMMA IRRADIATION (^{60}Co) ON THE TETRACYCLINES. Holland, J.; Antoni, F.; Galatzeanu, I.; Schulman, M.; Kozinets, G. (International Atomic Energy Agency, Vienna). pp 69-81 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

As part of a program to explore the feasibility of using radiation to sterilize packaged biomedical products, the radiosensitivity of tetracycline antibiotics was investigated. Various concentrations of oxy- and chloro-tetracycline were exposed to several dose levels of γ irradiation (10 to 11 Mrad at dose rates of 700 krad/hr) in the dry state, and in organic and aqueous solutions. Chemical changes were followed by visible and ultraviolet light absorption spectra and by thin-layer chromatography. Microbiological activity was assayed in parallel studies by the agar plaque technique. Both antibiotics were quite resistant to chemical or biological change in activity when irradiated in a dry state or organic solution. In aqueous solutions, however, doses as low as 25 krad produced significant inactivation. The foregoing data, modes of inactivation, and correlations between chemical structure and biological activity are discussed. The results suggest that the radiosterilization of tetracyclines in the dry state may prove to be technically practicable. (auth)

52103 GAMMA-RAY STERILIZATION IN OPHTHALMOLOGY. Ogg, A. J. (Salisbury Infirmary, Eng.). pp 49-54 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

Gamma irradiation is of considerable value in the sterilization of a number of inexpensive disposable medicaments and articles frequently used in ophthalmology. Saline is often required for irrigating the anterior chamber of the eye; the only completely safe way to prepare this solution is to pack, sterilize, store, and utilize the fluid in one container. A 10 cm^3 polystyrene syringe is filled with filtered saline and the nozzle closed with a Luer cap. Each syringe is packed in double heat-sealed polyethylene envelopes and γ irradiated to 2.5 Mrad. When required, the syringe is removed from the envelope and the Luer cap replaced with an irrigating cannula. Differences in pH value and sodium chloride concentration before and after irradiation are negligible; no untoward or toxic reactions have been observed following the frequent use of this system during the past two years, and no toxic reaction has followed the intradermal injection of saline into human volunteers after irradiation to 5 Mrad. In the case of more complex chemical substances, such as the antibiotics and local anaesthetics, a change in color and pH value may result from irradiation, and in some instances the potency of the drug may be inhibited or altogether lost; however, no cases of ocular toxicity have been observed. At the present time irradiated fluorescein and framycetin are being used for routine diagnosis and treatment. The solution is sterilized in a small unidose container, that is afterwards thrown away. A pack is described containing all the essential dressings required for an ocular operation, together with saline and framycetin drops. Such a pack reduces the time required to prepare a trolley for operation, and diminishes the risk of accidental infection. (auth)

52104 EFFECTS OF ^{60}Co GAMMA RAYS ON VITAMIN B_6 AND FOLIC ACID. Galatzeanu, I.; Antoni, F. (International Atomic Energy Agency, Vienna). pp 33-48 of Radiosterilization of Medical Products. Vienna, International Atomic Energy Agency, 1967. (In French).

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

A study was made of the behavior of pyridoxine and folic acid, including structural changes, after ^{60}Co γ irradiation. The irradiation of pyridoxine (vitamin B_6) and folic acid in aqueous solutions led to their partial or total destruction, depending on the dose. The irradiation of pyridoxine and folic acid in the solid state mainly resulted in the elimination of hydrogen atoms (free radicals). After dissolving the irradiated samples in acid solutions it was observed that the irradiated molecule was renewed through replacement of the eliminated hydrogen atoms, which depend on the pH-value of the solution. This indicates the possibility of sterilizing both pyridoxine and folic acid in the solid state by irradiation at 2 Mrad. Most of the radiolysis products of pyridoxine and folic acid irradiated in solution and in the solid state were separated and identified by means of chromatography (paper and thin layer) and cellulose column electrophoresis. Electron spin resonance was used to determine the concentration and nature of the free radicals after irradiation of pyridoxine and folic acid in the solid state. (auth)

52105 DATA ON THE RADIOSTERILIZATION OF SOME BASIC PHARMACEUTICAL MATERIALS. Hortobagyi, G.; Hangay, G.; Lukats, B.; Muranyi, G.; Zarandy, A. (Chemical Works of Gideon Richter Ltd., Budapest). pp 25-32 of Radiosterilize-

tion of Medical Products. Vienna, International Atomic Energy Agency, 1967.

From Symposium on the Radiosterilization of Medical Products, Budapest, Hungary. See STI/PUB-157; CONF-670644.

The effects of the normally accepted 2.5 Mrad sterilization dose of γ radiation and of a 5-Mrad dose on certain active pharmaceutical ingredients that cannot be heat-sterilized were tested using various physical and chemical procedures. Data are included on: desoxycorticosterone acetate, digoxin, hydrocortisone, estradiol benzoate, procaine hydrochloride, progesterone, and stilbestrol dipropionate. (C.H.)

52106 PRESENT STATUS AND FUTURE PROSPECTS OF FOOD IRRADIATION. **Southern, E. M. (Meat Research Inst., Cambridge, Eng.). Food Mfr., 42: 19-26(Jan. 1967).**

Radappertisation describes a radiation process which is intended to stabilize the product indefinitely by killing most, or ideally all, of the micro-organisms. It replaces the term irradiation sterilization. Radurisation and radicidation have distinct meanings which replace the 2 uses of the term irradiation pasteurization. Radurisation describes processes which are intended to destroy sufficient spoilage micro-organisms to extend the useful storage life of the food. Radicidation describes processes which are aimed at eliminating a specific organism constituting a public health hazard. Processes such as sprout inhibition in vegetables and ripening control of fruits do not fall within these definitions. The irradiated foods now permitted for human consumption, and the dose ranges and types of radiation used are compiled. The acceptability of irradiated foods, imminent legislation under consideration in England, microbiological safety, and the prospects for more extensive food irradiation are discussed. Potential applications of irradiation of meats, grains, fish, and dry animal feeds are discussed. Low temperature irradiation processes are described. (BBB)

52107 HYGIENIC ASSESSMENT OF IRRADIATED CHICKEN MEAT WITH PASTEURIZING DOSES OF γ RAYS. Shillinger, Yu. I.; Kachkova, V. G. (Inst. of Nutrition, Moscow). Gig. Sanit., No. 6, 44-8(June 1968). (In Russian).

The effect of chicken meat irradiated with pasteurizing doses of γ radiation (600 kilorad) was studied in experiments performed on albino rats. The daily six-month feeding of irradiated chicken meat, that made up 60% of protein and 50% of fat in the ration, had no harmful effect on experimental animals. (auth)

52108 GENETIC CONTROL OF AEDES AEGYPTI. **Craig, George B. Jr. (Univ. of Notre Dame, Ind.). Bull. World Health Organ., 36: 628-32(1967).**

The use of radiation and chemisterilants, and various other techniques, for genetic control of mosquitos is reviewed. The sterile-male technique, one method of genetic control, involves production and dissemination of dominant lethal factors. Unfortunately, mosquitos treated with radiation or chemicals generally show reduced reproductive fitness. However, genetic breeding methods can be used to produce mosquitos that are sterile but reproductively competitive. Several genes conferring sex-limited sterility have already been isolated. Crossing and inbreeding experiments have revealed lethal genes, subvitals, or sterility factors. Genes conferring inability to transmit disease could be incorporated into field populations by mass release of lab-reared carriers. Genes that modify host-choice or biting habits might be also useful. A major problem which must be solved before genetic control of A. aegypti can be applied is whether lab-reared genetic material can be introduced into field populations and whether the reproductive biology of this species is consonant with the sterile-male method or other techniques of genetic control. The evidence to date is negative. Thus, the release of 4,770,000 radiation-sterilized males in Pensacola, Fla., did not achieve any appreciable depression in field populations. Similar results were obtained with Anopheles quadrimaculatus and Culex fatigans. Several hypotheses are offered to explain these failures. (BBB)

52109 EFFECT OF MICROWAVE VS WATER BLANCHING ON NUTRIENTS IN BROCCOLI. **Eheart, Mary S. (Univ. of Maryland, College Park). J. Amer. Diet. Ass., 50: 207-11(Mar. 1967).**

A comparison was made of the retention of chlorophyll and ascorbic acid and the changes in pH and total acids in broccoli blanched by microwaves (short time), in water at 77°C (long time), and in water at 100°C (conventional method). Blanching by the 3 methods did not alter the pH. Broccoli blanched by microwaves was higher in total acids than when blanched in water at 100° or 77°C. The degradation of chlorophyll to pheophytin a, which was reflected in total chlorophyll values, was significant for all 3 treatments. All 3 methods caused significant losses of ascorbic acid. Microwave-blanched broccoli after storage and cooking was no higher in chlorophyll a than that blanched in 100°C water and was even lower in total chlorophyll. The greater retention of ascorbic acid in microwave-blanched broccoli was maintained during storage and subsequent cooking. (TSS)

52110 POSSIBLE USE OF THE STERILE-MALE TECHNIQUE FOR CONTROL OF AEDES AEGYPTI. **Smith, C. N. (Dept. of Agriculture, Gainesville, Fla.). Bull. World Health Organ., 36: 633-5(1967).**

Use of radiation and radiomimetic chemicals for sterilization of mosquitos and their eradication by the sterile-male technique are reviewed. The first investigations on induced sterility for mosquite control used γ radiation to sterilize males for release in the field. It was demonstrated that Anopheles quadrimaculatus could be radiosterilized in the pupal or adult stages, and that irradiated males competed, but not on equal terms, with normal males for normal females. Release of 1500 sterilized males/Km^2/week for 11 months on a small, incompletely isolated island in Lake Okeechobee, Fla., had little effect on the fertility or abundance of the wild females. The release of irradiated males of Culex fatigans resulted in the appearance of considerable numbers of egg rafts in which the eggs were embryonated but did not hatch. There was no reduction in mosquito abundance, possibly because the numbers released were inadequate. Radiomimetic chemicals provide some advantages over radiation in the sterilization of insects for release and, in addition, open the possibility of inducing sterility in a large part of the natural population without the necessity of rearing and releasing large numbers of males. At present, it appears that the prospects for controlling A. aegypti with chemosterilants applied to the natural population are not good and depend largely on the development of safer, more stable, and more effective sterilants. (BBB)

52111 RADIATION STERILIZATION OF MEAT. **Hansen, P.-I. E. (Danish Meat Research Inst., Roskilde, Denmark). Process Biochem., 1: 487-8; 495(Dec. 1966).**

After introductory remarks about food irradiation in general and its relation to other preservation techniques, some problems of irradiation treatment of meats, in particular chemical and enzymatic changes, are reviewed. Animal tissue contains about 75% water so that the main irradiation-produced chemical changes in meat are the result of secondary reactions. The main attack on proteins and peptides occurs as cleavage of side chains on end groups. Irradiation in the presence of oxygen produces a rupture of N–C bonds rather than the usual hydrolytic break in the peptide chain. This, however, leads basically to the same reaction products (amides and carbonyls) as does anaerobic irradiation. The most radiosensitive amino acids in proteins are the sulfur-containing acids (cystine, cysteine, and methionine), serine, threonine, and amino-acids containing aromatic groups like imidazole (histidine), phenyl (tyrosine and phenylalanine), and indole (tryptophan). In the presence of oxygen the main reaction of the sulfur amino acids leads to higher oxidation products (sulfones, sulfoxides, etc), but in vacuum or inert gas some reduction to hydrogen sulfide and mercaptans occurs. Irradiation of lipids and fats results in the production of carbonyls and other oxidation products (e.g. peroxides), particularly if irradiation and storage take place in the presence of oxygen. Increased susceptibility to autoxidation has been noted in irradiated fats. The main products of irradiation of dry oxygen-free lipids are the homological series of n-alkanes, n-alkenes, and traces of n-alkynes. When red meat is irradiated at high doses (1.5 mRad or higher) appreciable quantities of the myoglobin are converted into metmyoglobin, and a green pigment, sulfmyoglobin, is produced. A major problem with regard to radiation sterilization of meats is the lack of inactivation of enzymes, which may require an additional heat treatment to prevent autolysis. (BBB)

52112 TOXICITY OF X-IRRADIATED WATER-SOLUBLE IODINATED CONTRAST MEDIA. **Svoboda, Milan; Puchta, Vladko (Inst. for Hematology and Blood Transfusion, Prague). Roentgen Bl., 19: 103-6(Feb. 1966). (In German).**

Results of studies of the toxicity of 70% diodone, 35% acetrizoate, 60% diatrizoate, 50% adipiodone, and 50% ioglykamide in a total of 1120 mice previously exposed to 100, 1000, and 10,000 R of 180-kV x irradiation are reported. The rate of irradiation was 428 R/min. The contrast media were administered intravenously. The LD_{50} values obtained showed no statistically significant differences between the irradiated and control groups before and after irradiation. No potentiation of reactivity was evident even at the irradiation dose of 10,000 R. The LD_{50} values for all of the media ranged from 3 to 6 g/kg, except for diazotrate, which had an LD_{50} value of 12 to 13 g/kg. The author also concludes that the toxicities of contrast media in addition to being unaffected by x irradiation, are not in any way related to the free I present. (BBB)

52113 INTRODUCTION TO INDUSTRIAL STERILIZATION. **Richards, J. W. London, Academic Press, 1968. 183p. 50s.**

A section is included on radiation sterilization, with the following headings: Use of radiation for sterilization and disinfection; resistance of organisms to irradiation; industrially important radiations (gamma irradiation, electron beam sterilization, ultraviolet irradiation); deleterious effects of irradiation; legal requirements. (UK)

52114 ^{32}P LABELLING OF CODLING MOTH (CYDIA POMENELLA L.). Bengston, M. (Granite Belt Horticultural Research Station, Applethorpe, Australia). Queensland J. Agr. Anim. Sci., 24: 113-15(Mar. 1967).

Preliminary to attempts to develop a sterile-male method for elimination of the codling moth, labeling of spermatophores with radioisotopes was tested to provide a direct method of assessing competitive ability of treated males. Effects of ^{32}P on reproductive ability were tested. Newly emerged male codling moths were labeled by ^{32}P as orthophosphate in a feeding period of 24 hr. Transference of isotope material to females was achieved by mating. Radioactive spermatophores were detected by autoradiography in 95% of females caged with treated males. A concentration of 0.1 mCi/ml appeared to give optimum results. No detrimental effect on reproductive potential was evident at concentrations as high as 0.44 mCi/ml. Such concentrations did not affect egg laying or larval emergence. (BBB)

52115 EFFECT OF SPECIAL HANDLING OF HADDOCK ON THE POSTIRRADIATION SHELF LIFE OF HADDOCK FILLETS. Ampola, Vincent G.; Ronsivalli, Louis J. (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.). Fish. Ind. Res., 4: 109-11(June 1968).

Freshly caught eviscerated haddock, washed and manually cleaned of intestinal and liver remnants, were packed with ice and stored in ice for 12 and 14 days. Irradiated fillets cut from these fish were stored at 33°–35° F and organoleptically tested as were irradiated fillets cut from commercially handled fish that had been stored in ice for up to 11 days. The markedly longer postirradiation shelf life obtained from fillets cut from haddock that were specially handled prior to being stored in ice as compared with the shelf life of fillets from commercially handled haddock indicates that a direct economic advantage is to be gained in using, for the radiopasteurization process, haddock that were given special handling and icing techniques after capture and prior to storage. (auth)

52116 EFFECT OF GAMMA RADIATION ON THIAMINASE ACTIVITY IN FRESH-WATER FISH. Krzeczkowski, Richard A. (Bureau of Commercial Fisheries Technological Lab., Ann Arbor, Mich.). Fish. Ind. Res., 4: 133-8(July 1968).

Sensitivity to gamma radiation of the antimetabolite thiaminase in whole fish was studied so that the potential usefulness of this radiation for controlling the activity of thiaminase in fishery products could be estimated. Although gamma radiation will partially inactivate thiaminase in the species studied, its use for complete inactivation does not appear to be economically feasible. (auth)

52117 IRRADIATION OF PACIFIC COAST FISH AND SHELLFISH. 6. PRETREATMENT WITH SODIUM TRIPOLYPHOSPHATE. Spinelli, J.; Pelroy, G.; Miyauchi, D. (Bureau of Commercial Fisheries Technological Lab., Seattle, Wash.). Fish. Ind. Res., 4: 37-44(Dec. 1967).

Dipping fish fillets and steaks into sodium tripolyphosphate-salt solutions of appropriate concentrations (7.5-percent sodium tripolyphosphate containing 2 percent of salt) prior to irradiation is compatible with the irradiation-pasteurization of these products. Pretreatment has an economic advantage in that, during storage, drip is minimized, the original appearance of the fish is largely retained, and the texture is less altered, particularly with such species as halibut and Pacific Ocean perch. Dipping does, however, result in a marked but not serious increase in slipperiness of the fish. Other factors relating to flavor or to odor were not affected. Treatment with sodium tripolyphosphate-salt solutions did not significantly alter the salt-soluble, myofibrillar, and nonprotein nitrogen content of the fillets during storage. No significant differences were found in the spoilage flora between treated and untreated vacuum-packed fillets. Thus, the overall effect of dipping fillets and steaks into sodium tripolyphosphate-salt solutions of appropriate concentrations was beneficial. (auth)

52118 ORGANOLEPTIC QUALITY OF IRRADIATED PEACHES. Merkley, Margaret S.; Kuhn, G. D.; Dennison, R. A. (Univ. of Florida, Gainesville). Food Technol., 22: 89-90(July 1968).

Texture and taste evaluations were made of different varieties of peaches γ-irradiated (^{60}Co) with doses of 100 to 450 Krad. Loring and Southland peaches given various irradiation doses and Dixiland peaches irradiated at five stages of ripeness revealed a definite corelation between organoleptic responses and ripeness. Organoleptic quality of Dixiland peaches given a 200 Krad dose was not significantly lowered, provided fruits were irradiated when firm-ripe (4.4 to 5.3 lb pressure measured by the Magness-Taylor fruit tester). However, when irradiation was conducted before peaches reached firm-ripeness, the quality was significantly lowered. Quality of Southland and Loring peaches irradiated firm-ripe declined linearly with increasing doses, but was not significantly lowered with 200 or less Krad. The findings in the study clearly illustrated that the ripeness of fruit at the time of irradiation greatly influenced the quality of irradiated peaches. (BBB)

52119 RADIATION CHEMISTRY OF FOODS. PART I. REACTION RATE CONSTANTS OF SOME FOODS CONSTITUENTS WITH HYDRATED ELECTRONS AND HYDROXYL RADICALS. Fujimaki, Masao; Morita, Makio (Tokyo Univ.). Agr. Biol. Chem. (Tokyo), 32: 574-9(May 1968).

In irradiated food, water-soluble constituents undergo attack from e^-_{aq} and OH radicals at neutral pH. Reaction rate constants of some food constituents with e^-_{aq} and OH radicals were measured by competition methods, using nitrous oxide and ^{3}H-formate as competitors. High selectivity was observed among the reactions with e^-_{aq}, and the e^-_{aq} reaction rate constants were $10^{10}\underline{M}^{-1}$ sec^{-1} for cysteine; $10^9\underline{M}^{-1}$ sec^{-1} for methionine, ascorbic acid, and histidine; and much smaller for sugars and the other types of amino acids. The OH reaction rate constants ranged from $10^9\underline{M}^{-1}$ for cysteine, histidine, methionine, aromatic amino acids, and ascorbic acid to $10^8\underline{M}^{-1}$ sec^{-1} for sugars and the other amino acids, indicating that the reactions with OH are less selective. Selective destruction of cysteine and ascorbic acid in food by irradiation may be partly ascribed to their selective reactivities with some less reactive species that are produced by reactions of e^-_{aq} or OH with oxygen or the other constituents as well as their higher reactivity with e^-_{aq}. (BBB)

52120 IRRADIATION OF MANGOES FOR CONTROL OF THE MANGO SEED WEEVIL. Upadhya, Mahesh D.; Brewbaker, James L. (Univ. of Hawaii, Honolulu). Hawaii Farm Sci., 15: 6-7(Jan. 1966).

A small weevil that burrows directly into the mango seed, and is rarely seen, is the basis for federal quarantine regulations that exclude Hawaiian mangoes from the U. S. mainland. Experiments indicated that this weevil, Sternochetus mangiferae, would probably cause no damage to temperate zone fruits. Since the insect was restricted to the hard-shelled seed, standard fumigation methods were almost wholly ineffective against it. γ rays readily penetrate mangoes even when packaged, and studies were conducted to determine the levels of irradiation that kill or sterilize the weevil. Experiments at the University of Hawaii were conducted with mango fruits showing 30 to 50% seed weevil. Fruits were irradiated in the ^{60}Co Hawaii Research Irradiator, stored at 48°F for three to five weeks, and then scored for live or dead weevils. Adult weevils showed no survival following 120 Krad and three weeks of storage, while 60 Krad sufficed for complete lethality after five weeks of storage. In general, ripe fruits irradiated with doses up to 150 Krad could not be distinguished from the unirradiated controls in taste, appearance, or other criteria. When treatments exceeded 150 Krad, ripe fruits were often scored off-flavor by taste panels, and conspicuous loss of flavor and aroma was observed above 250 Krad. Electrophoretic separation and staining for several enzymes revealed no changes at levels below 200 Krad, either immediately after irradiation or upon protracted storage. Lower limits of obvious irradiation injury appeared to be about 150 Krad for Pirie and Haden mango varieties. Above these levels skin blemishes were detected. The blemishing or scaling was similar to that of chilling injury, and developed extensively in fruits irradiated above 200 Krad. The common Chinese mangoes were considerably more sensitive to this type of blemish, following both irradiation and chilling. (BBB)

52121 REVIEW OF THE FOOD IRRADIATION PROGRAM. HEARING BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-NINTH CONGRESS, SECOND SESSION, SEPTEMBER 12, 1966. Washington, D. C., Joint Committee on Atomic Energy, 1967. 348p. GPO $1.00.

A report on the hearing of September 12, 1966, on the food irradiation program is presented. Topics include statements from Atomic Energy Commission witnesses, statements of other witnesses, statements submitted for record, additional material submitted for record, and correspondence inserted in the record. Various appendices associated with food irradiation are also presented. (B.G.D.)

52122 PROSPECTIVE USE OF RADIATION TO CONTROL THE HOLLYHOCK SEED MOTH (LEPIDOPTERA, GELECHIIDAE).

Azaryan, G. Kh.; Babayan, A. S.; Vasilyan, V. V.; Mkrtumyan, K. L. (Armenian Agricultural Research Inst., Erevan). Entomol. Rev. (USSR) (Engl. Trans.), 44: 449-53(1966).

Translated from Entomol. Obozrenie, 44: 762-9(1966).

The possibility of radiosterilization of the hollyhock seed moth was investigated with the use of x rays at doses of 4,000 to 6,000 R. The radiation effect depended on the age of the pupae. One- or two-days-old pupae were most radiosensitive. Moths from these pupae laid single eggs or were sterile. A dose of 5,000 R was most effective, causing sterility of 100% of the moths in the combination of irradiated male plus non-irradiated female. Summer and winter generations were found to have about the same radiosensitivity. Single radiation doses had higher biological effect, yielding the largest number of externally normal moths and the least number of fertile moths. Irradiated pupae resulted in a far shorter egg-laying period in the moth; no difference in life span was found between irradiated and non-irradiated moths. (C.O.)

52123 PROGRESS OF FOOD IRRADIATION WORK. Food Irradiat., 8: No. 3, 2-51(Jan.-Mar. 1968).

The food irradiation research programs in the following countries are discussed: Austria, Canada, Denmark, France, Germany, Israel, United Kingdom, United States (civil and military), Japan, Portugal, and Spain. In each country included in the discussion, the review describes research in the areas of: control of microbial populations, radiation effects on organoleptic and nutritional properties of the food, analytical methods, effects of feeding irradiated foods to animals, and the legal aspects of food irradiation in the respective countries. (E.R.B.)

52124 MORTALITY STAGING OF DOMINANT LETHALS INDUCED IN THE F_1 GENERATION OF THE SUGARCANE BORER; DIATRAEA SACCHARALIS (F.). Walker, David W.; Quintana-Muniz, Victoriano (Puerto Rico Nuclear Center, Mayaguez). Contract AT(40-1)-1833. Radiat. Res., 36: 138-43(1968). (TID-24302).

Comparative egg maturation was observed between γ fertile eggs laid by unirradiated females, by unirradiated females mated with γ irradiated males, by γ irradiated females mated with normal males, and by virgin unirradiated females. Haploid eggs turned yellow and dried by the fifth day. Eggs from irradiated parents developed more slowly than normal eggs. Most embryos from parents irradiated as P generation adults at 16.8 kilorads for males and 12.^ kR for females die early in embryonic development. A description of egg development is included. (auth)

52125 IONIZING RADIATION FOR CONTROL OF POST-HARVEST DISEASES OF FRUITS AND VEGETABLES. Sommer, N. F.; Fortlage, R. J. (Univ. of California, Davis). Advan. Food Res., 15: 147-93(1966).

The following topics are reviewed: fungicidal and fungistatic effects of radiation (radiobiology, factors affecting dose requirements, and mutations), techniques for postharvest disease radiation studies (in vitro and in vivo studies), nature and causes of postharvest diseases, disease-control investigations, irradiation-induced susceptibility to infection, protective packaging, and research needs. (190 references) (TSS)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

52126 (BNL-50127) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 6, Number 3. (Brookhaven National Lab., Upton, N. Y.). June 1968. 139p. Dep. CFSTI.

High-temperature liquid-metal technology applicable to the fast breeder reactor development and to the development of nuclear-Rankine power systems for space vehicles is reviewed. Materials development, corrosion and mass transfer, heat transfer, fluid dynamics, instrumentation, purification, component development, physical properties, thermodynamics, chemical analysis, and power systems are discussed. (J.C.W.)

52127 (RISO-179) METALLURGY DEPARTMENT ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1968. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1968. 42p. Dep.

Developments are reported for studies on: mechanical testing and metallography of Zircaloy-2; dispersion-strengthened zirconium alloys; precipitation reaction in a Zr-Cr-Fe-alloy; distribution of the alloying elements in the oxide film of Zr-Cr-Fe-alloys; corrosion testing of Zircaloy and Zr-Cr-Fe-alloys; fabrication of UO_2 pellets; Zircaloy fuel elements and vibratory-compacted fuel rods for water-cooled power reactors; in-pile thermal conductivity of UO_2; post-irradiation examination of UO_2-pellet fuel specimens and vibratory-compacted fuel pins; fabrication of MTR fuel elements; roll swaging; pressure vessel steel irradiations and post-irradiation examination; dispersion strengthening and effect of a matrix substructure on the flow stress of Al/Al_2O_3-products; aluminium powder; stainless steel powder; work hardening and fiber reinforcement of the system copper-tungsten; rolling texture in face-centered cubic metals and alloys; brazing of tantalum and niobium to copper and stainless steels; electroless nickel plating; D_2O-loop boiling experiment; welding of metal-sheathed thermocouples. (auth)

52128 *METHODS OF MATERIALS SELECTION.* Based on a Symposium, Gainesville, Fla., May 1966. Verink, Ellis D. Jr. (ed.). Metallurgical Society Conferences. Volume 40. New York, Gordon and Breach, Science Publishers, Dec. 1966. 318p. $15.40. (CONF-660577).

A total of eleven papers was presented at the conference. A separate abstract was prepared for each of three papers. Papers for which no abstracts were prepared are concerned with steels, aluminum and its alloys, copper and its alloys, materials for subsonic airframes, materials for petroleum industry, materials for chemical industry, and materials for automotive industry. (J.R.D.)

For abstracts of individual papers see: 52142, 52191, and 52192.

Corrosion and Erosion

Refer also to abstracts 52239 and 53315.

52129 (AN-AGCR-953) EVALUATION OF HASTELLOY X ML-1 TUBING (HEAT E9517) EXPOSED IN AIR FOR DURATIONS UP TO 10,000 HOURS. Brunhouse, J. S. (Aerojet-General Nucleonics, San Ramon, Calif.). Nov. 4, 1965. Contract AT(10-1)-880. 22p. Dep. CFSTI.

A test program was conducted to determine whether the Hastelloy X tubing used in the ML-1-I fuel elements was suitable for 10,000-hr operation with an air coolant. The data indicate that the Hastelloy X tubing will perform satisfactorily for 10,000 hr at all temperatures experienced in the reactor. The observed degradation of physical properties, the extent of oxidation attack, and the observed metallurgical changes are all considered acceptable. In addition, information was gained which indicates operation of ML-1 fuel elements at a hot spot of 1800°F for 10,000 hours is feasible. (D.L.C.)

52130 (ANL-Trans-666) THE EFFECT OF CALCIUM CONTENT IN SODIUM UPON THE CORROSION OF VANADIUM AND THE ALLOY V-10 WT. PERCENT Ti. Schneider, H.; Borgstedt, H. U.; Drechsler, G.; Frees, G. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from J. Nucl. Mater., 25: 347-9 (1968). 5p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 23723. (R.C.K.)

52131 (BNWL-756) SPALLATION THRESHOLD TESTS ON NIOBIUM, TANTALUM, AND ZIRCONIUM. Hanneman, G. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 12p. Dep. CFSTI.

Niobium, tantalum, and zirconium specimens were heated to elevated temperatures in less than 8.0×10^{-6} sec by capacitor discharge. The ratio of heating time to thermal expansion time was maintained at unity or less to induce large tensile stresses. Single or multiple spallation was determined to occur in a plane normal to the long axis when temperature rose above a certain threshold. Spall threshold was found to be in the range of 1730 to 1860°C for niobium, 1900 to 2140°C for tantalum, and 1150 to 1200°C for zirconium. (auth)

52132 (N-68-23458) HIGH-TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS. Progress Report, October 21, 1967-January 21, 1968. Rexer, J. (Union Carbide Corp., Parma, Ohio. Carbon Products Div.). [1967]. Contract NASw-1405. 9p. (NASA-CR-94568; PR-7). CFSTI.

The objectives of the work were: to measure the change in thickness of an iridium coating on tungsten, molybdenum, and niobium annealed at several temperatures for various times; and to examine the mechanical behavior of iridium-coated and heat-treated specimens with a microbend tester. Two molybdenum-iridium diffusion couples previously hot-pressed were sectioned and microscopically examined for intermetallic compound formation. A strip from each hot-pressed couple was bent in flexure to determine bending strength of the composites and of heat-treated, uncoated, molybdenum. Cracks initiated in the composite during bending at the outer iridium surface and propagated through the iridium towards the molybdenum-iridium interface. Additional sections of the hot-pressed couples were metallographically polished on one surface, and the thickness of the iridium coating measured microscopically. The specimens were then annealed and remeasured for loss of iridium as a function of time and temperature. (auth)

52133 (N-68-23469) FUNDAMENTALS OF THE OXIDATION PROTECTION OF COLUMBIUM AND TANTALUM. Semiannual Report, October 1, 1967-April 1, 1968. Kolodney, M.; Graff, R. A. (City Coll., New York). 31p. (NASA-CR-94582; SAR-5). CFSTI.

An investigation of the fundamental processes involved in the protection of tantalum and niobium by their silicides is in progress. The first part is devoted to establishing thermochemical data for the silicides and employs an entirely solid state electrochemical cell. The second part deals with the protection of both coating and substrate by the protective glass formed during oxidation. In the third part, oxidation rates and the possibility of using coating modifiers to promote the formation of glassy films is tested. The formation of intermediate phases between the silicide and the substrate are being investigated in the fourth part of the program along with the efficacy of diffusion barriers to retard intermediate phase growth. Preliminary results on the rate of oxidation of $TiSi_2$ between 300 and 1200°C are presented. New information on interphase growth in the $Ta-TaSi_2$ system has been obtained. A new line of investigation on silicide reactions has been added. (auth) (TAB)

52134 CORROSION: ITS PRICE GOES UP STEADILY. O'Keefe, William. Power, 112: No. 9, 185-92(Sept. 1968).

The cause and effect of corrosion processes which occur in energy systems, i.e., boilers, condensers, and piping, are examined briefly, and methods for reducing corrosion are discussed. (L.C.L.)

52135 OXIDATION OF MILD AND LOW-ALLOY STEELS IN CO_2 BASED ATMOSPHERES. Antill, J. E.; Peakall, K. A.; Warburton, J. B. (Atomic Energy Research Establishment, Harwell, Eng.). Corros. Sci., 8: 689-701(Sept. 1968).

The behavior of pure Fe, a rimming steel, and three low-alloy steels was fully characterized in CO_2 containing small amounts of CO and H_2O at 500°C. Emphasis was given to the provision of basic data to assist in the identification of the mechanisms responsible for the formation of nonprotective oxide, together with linear oxidation rates. Essential conditions for nonprotective oxidation are the presence of water vapour and a high pressure of CO_2. The adverse influence of water vapor was found to be enhanced by deposits of Au, C, and Pt on the metal. C may be transferred from the gas phase as several per cent of the O transfer by the Boudouard or a similar reaction, utilizing CO produced by prior oxidation of the metal with CO_2. Two tentative mechanisms are advanced to explain nonprotective oxidation. (auth) (UK)

52136 ANODIC PASSIVATION AND POLISHING OF TUNGSTEN IN ALKALI SOLUTIONS. Faizullin, F. F.; Levina, V. K. Elektrokhimiya, 3: 1225-8(Oct. 1967). (In Russian).

The anodic behavior of W in 0.1 N- and N-KOH solution was studied with emphasis on passivation effects and surface polishing. The experiments were based on potentiostatic polarization curves. Depending on the potential, the W assumed one of four possible states: 'cathodic passivation', active anodic dissolution, the ordinary passive state, and the brightened or polished state. The surface film had n-type conductivity in all cases. The fourth state was reached from the third when the passivating film broke up. (auth)

52137 *RECENT RADIOACTIVE TRACER METHOD MEASURES LEACHING RATE OF CHROMIUM.* Glass, Alfred L. (Naval Air Development Center, Johnsville, Pa.). Mater. Protect., 7: 26-30(July 1968).

A new radioactive tracer procedure was developed using ^{51}Cr to measure in situ the leaching rate of Cr from chemically chromated Al surfaces. The equipment used to measure solution rates of Cr is shown. During the test, the leaching medium in a cell was circulated by a pump through a side-arm test tube located in the well of a bench-type scintillation counter which was enclosed in a lead shield. A ratemeter converted the electrical pulses from the scintillation counter to cpm and the measurements were then recorded by the recorder. Two mCi of carrier-free $Na_2{}^{51}CrO_4$ having a specific activity of 86.63 mCi/mg were used. Data are presented which show the effects of film thickness, aging period after treatment, elevated temperature, and duration of immersion in salt water. Correlative data on the effect of elevated temperature and resistance to salt spray corrosion are also presented. The results are rationalized to explain the structural changes occurring in chromate films formed on aluminum alloy surfaces. (BBB)

52138 INVESTIGATION OF THE OXIDIZABILITY OF THE ALLOYS Nb–V, Nb–Zr, AND Nb–Zr–V AT THE TEMPERATURES 500 TO 900°C. Tregubov, I. A.; Grigor'ev, A. T. Izv. Akad. Nauk SSSR, Metal., No. 4, 209-11(July-Aug. 1968). (In Russian).

The oxidizability in air in the temperature interval from 500 to 900°C is investigated on a series of two Nb-base alloys with additions of V or Zr and one ternary alloy. Additions of 1 to 5 wt % V slightly improves the scaling of Nb in the temperature interval. Alloying Nb with 10% V increases scaling only at 500 and 600°C. With increase of the temperature up to 900°C the stability of oxide films is impaired. Very high alloying (15 and 20% V) negatively affects the oxidizability of Nb. Additions of Zr and Nb affect V analogously. The difference consists in the fact that the slightest weight increase at 500, 600, and 700°C was shown by alloys alloyed with 20% Zr. The ternary alloys with 15 to 20 wt % V and Zr acted at 500 to 600°C with respect to stability as binary alloys of Nb with 10% V or 20% Zr. (tr-auth)

52139 IN-PILE CORROSION OF ZIRCALOY-2 IN STEAM–WATER MIXTURES. Cerrai, E.; Gadda, F.; Scaroni, A. (CISE, Milan). Energ. Nucl. (Milan), 15: 726-31(Nov. 1968).

Experiments are described concerning the in-pile corrosion of Zircaloy-2 specimens in contact with steam–water mixtures at 250 to 280°C. Comparison with out-of-pile results shows a noticeable increase in the in-pile corrosion rate. (auth)

52140 HOW SODIUM POTASSIUM EUTECTIC ALLOY AFFECTS TYPE 316 STAINLESS STEEL. Hoffman, T. L.; Moen, R. A.; Sumpter, K. C. (Idaho Nuclear Corp., Idaho Falls). Mater. Protect., 7: 35-9(May 1968).

Service tests were conducted on a stainless steel loop upstream from the NaK heater in a waste calcining facility which is a fluidized bed calciner for converting highly radioactive aqueous waste into granular solids. Heat is supplied to this calciner by circulating NaK eutectic alloy at 1400°F through a bayonet heat exchanger in the fluidized bed of solids. The most significant service-associated effect observed in the Type 316 stainless steel of the NaK loop was the formation of sigma phase throughout the whole cross section of the pipe and accompanying evidence of embrittlement. Precipitation of carbides at the grain boundaries was observed, but general corrosion damage was limited to a 2-mil thick band of decarburized alloy on the inside surface of the pipe and a 0.3-mil thick film of oxide on the outside surface. In areas relatively free of stress, cracking was not present. Where stress was present, serious and extensive cracking occurred. The tensile strength of the exposed metal remained high, but ductility was seriously reduced compared to new material. The most likely mechanism of failure was thermal fatigue and/or brittle fracture in stressed areas, and not corrosion, thus prediction of the remaining service life was not feasible. After a total operating time of the NaK loop of 28,600 hr, the NaK system was still operating satisfactorily. (BBB)

52141 CORROSION OF LONG BeO PRODUCTS IN HUMID GAS FLOWS. Belyaev, R. A.; Danilov, Yu. I.; Furaev, S. A. At. Energ. (USSR), 25: 305-8(Apr. 1968). (In Russian).

Corrosion of long BeO shapes (i.e., shapes with high ratio l/d, where l — length and d — working diameter) was investigated in high speed (~150 m/sec) flow of humid gas. The experimental data support the supposition that local corrosion rate of long shapes (when the temperature along the whole length is constant) is sharply falling in direction of gas flow. Consequently, the average specific losses ($mg/cm^2/hr$) are dependent on 1/d. (tr-auth)

52142 NICKEL AND HIGH-NICKEL ALLOYS. Friend, W. Z. (International Nickel Co., Inc., New York, N. Y.). pp 89-107 of Methods of Materials Selection. Verink, Ellis D. Jr. (ed.). New York, Gordon and Breach, Science Publishers, Dec. 1966.

From 1st Symposium on Methods of Materials Seclection, Gainesville, Fla. See CONF-660577.

The properties of Ni and Ni alloys which make them useful in chemical process industries are discussed and the chemical composition of a number of nickel alloys are tabulated. Specific chemical process industry uses of commercial Ni, Cu–Ni, Cr–Ni, Cu–Ni, Ni–Mo, Cr–Mo–Ni, Cr–Cu–Mo–Ni, Cr–Fe–Mo–Ni, and Ni–Si alloys are given and discussed. (F.S.)

Preparation and Fabrication

Refer also to abstracts 52174 and 53456.

52143 (BNWL-825) ZIRCONIUM ELECTROPLATING ON URANIUM FROM MOLTEN ALKALI FLUORIDE SALTS. Nissen, D. A.; Stromatt, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1, 1968. Contract AT(45-1)-1830. 33p. Dep. CFSTI.

Conditions were established under which zirconium could be electroplated onto uranium from molten alkali fluoride melts. Although good electroplates were made from several such solvents over a fairly wide range of conditions, the best results were obtained using the KF–LiF eutectic under the following conditions: current density from 20 to 40 mA/cm^2, temperatures from 625 to 675°C, and ZrF_4 concentration from 2 to 10 wt %. The zirconium plates were fine grained and non-porous up to a thickness of about 5 mils, after which isolated crystallites began to grow. It was proposed that the change in plate structure was related to chemical changes in the electrolyte. A method to prevent melt degradation was proposed, and an attempt to test the method was made. (auth)

52144 (BNWL-865) STUDY OF TUNGSTEN–TECHNETIUM ALLOYS. Concluding Progress Report, October 1, 1966–August 1, 1968. Nelson, R. G.; O'Keefe, D. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 51p. Dep. CFSTI.

Fabrication methods for sheets of Tc–W forged alloys are described. Ductile-to-brittle transition temperatures are measured for the alloys. Cold-work, recrystallization, and tensile data are presented for pure Tc. (6 references) (D.C.C.)

52145 ACTIVATION MECHANISM OF THE ELECTRODEPOSITION OF AN IRON–NICKEL–MOLYBDENUM ALLOY IN AN ULTRASONIC FIELD. Fedotova, N. Ya.; Ginberg, T. A.; Vagramyan, A. T. Elektrokhimiya, 3: 1111-14(Sept. 1967). (In Russian).

The kinetics of the cathodic process governing the electrodeposition of Fe–Ni–Mo alloys in an ultrasonic field were studied with emphasis on the activation mechanism responsible for the relatively high proportion of Mo obtained in alloys deposited under these conditions. The overall polarization curves were analyzed and decomposed into partial curves characterizing the three separate components of the alloys and interpreted in terms of the mechanisms responsible for the deposition of each. The increased amount of Mo in the alloys deposited in the ultrasonic field was largely due to the disruption of passive surface films by cavitation effects. (auth)

52146 PREPARATION OF NIOBIUM AND TANTALUM METAL POWDERS BY CALCIOTHERMIC REDUCTION OF THEIR PENTOXIDES. Sehra, J. C. (Bhabha Atomic Research Centre, Bombay); Bose, D. K.; Jena, P. K. Trans. Indian Inst. Metals, 21: No. 1, 21-3(Mar. 1968).

Niobium and tantalum metal powders have been prepared by calcium reduction of their pentoxides at about 950°C in an argon atmosphere in presence of anhydrous calcium chloride. The effects of the reduction temperature, amount of calcium, and amount of anhydrous calcium chloride on the yield and quality of the metal powder have been investigated. In a typical run a

yield of 91% in case of tantalum (200 g of Ta_2O_5 per batch) and 85% in case of niobium (100 g of Nb_2O_5 per batch) has been achieved by using 1.5 moles of calcium chloride per mole of oxide and 50% of calcium in excess of stoichiometric amount. Powder metals thus obtained were arc (non-consumable) and electron beam melted. The electron beam melted samples were found to be quite pure and could be cold-rolled to over 90% reduction without intermediate annealing. (auth)

52147 PREPARATION OF ZIRCONIUM METAL FROM ZIRCONIUM CARBIDE BY FUSED SALT ELECTROLYSIS. Venkataramani, K. (Indian Inst. of Tech., Bombay); Mallikarjunan, R.; Sundaram, C. V. Trans. Indian Inst. Metals, 21: No. 1, 36-41 (Mar. 1968).

Preparation of sintered zirconium carbide, and production of zirconium metal by fused salt electrolysis, using the carbide as a soluble anode were studied. The conversion efficiency in the preparation of zirconium carbide—by reacting a bonded charge of ZrO_2 and carbon in the temperature range of 1300 to 1800°C in vacuum—was found to increase with temperature, and at higher temperatures, it decreased with holding time. Near stoichiometric carbide was obtained at 1800°C after 1 hour holding. Sintered anodes were prepared by pre-compacting the zirconium carbide powder along with 5% zirconium powder as sintering aid, and sintering the pellets at 1700°C to >90% of theoretical density. Tests were carried out with sintered zirconium carbide compacts as anode and with stainless steel as cathode in a sodium chloride-potassium chloride-potassium zirconium fluoride bath at different temperatures and at different current densities to arrive at the optimum conditions for the electro-deposition of pure metallic zirconium. With a bath composition of sodium chloride-potassium chloride eutectics and potassium zirconium fluoride in the ratio of 2:1 at 830°C and at a current density of 300 A/dm^2, cathodic and anodic efficiencies of 68 and 87 per cent were obtained, the cathodic deposit being shining and dendritic. (auth)

52148 ALUMINOTHERMIC REDUCTION OF MOLYBDENUM DISULPHIDE AND CONCENTRATED MOLYBDENITE. Mehra, O. K.; Gupta, C. K.; Jena, P. K. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: No. 1, 45-8(Mar. 1968).

Molybdenum metal was obtained in button form by the aluminothermic reduction of MoS_2 and concentrated molybdenite in an enclosed magnesia-lined mild steel vessel. A small amount of Ca and S was incorporated in the charge to trigger the reaction at a comparatively low temperature, of the order of 450°C, (outer wall temperature of the vessel) and to supply extra heat for the consolidation of the metal. The influence of the amount of Al on the yield and quality has been studied in the reduction experiments with synthetic molybdenum disulfide. In a typical run consisting of 100 g of MoS_2 and 20.25 g of Al, which corresponds to 90% of the stoichiometric amount, with 10 g of Ca and 8 g of S, the massive metal yield was 90% showing an excellent slag-metal separation. The metal thus obtained was non-consumably arc-melted in argon atmosphere and was found to be pure with a hardness of about 180 DPH. Electron-beam melting of the arc-melted sample brought down the hardness of the metal to as low as 150 DPH. In a similar manner, massive Mo metal has also been produced on a 200 g scale of the molybdenite concentrate (~98% MoS_2) is such and also after high temperature (~800°C) vacuum treatment. The metal so obtained is found to be quite pure comparable to that from the synthetic MoS_2. (auth)

52149 RESEARCH WORKS ON THE WELDING OF ULTRA-THICKNESS ASTM A 302B STEEL PLATES FOR REACTOR PRESSURE-VESSELS. Yosetsu Gijutsu, 16: No. 1, 73-80(Jan. 1968). (In Japanese).

Research on the welding of domestic A 302B steel plates with thickness 250 mm, with the purpose of establishing the most suitable welding and associated methods is reported. The results of research on base metals; welding materials and welding methods such as coated-electrode and submerged arc-weldings; joints performance; and future problems are described. (NSA of Japan)

52150 FABRICATION OF BERYLLIUM FOIL. (to United States Atomic Energy Commission). British Patent 1,128,565. Sept. 25, 1968. Priority date Nov. 23, 1965, United States.

Beryllium metal sheets are rolled to a thickness of 0.005 in. or less by encapsulating the sheet in an air-tight envelope of mild steel, SAE 4340 steel, or a metal having similar characteristics that is free from oxide or scale. Rolling temperatures are in the range of 600 to 800°C. The foil is released from the envelope after rolling by heating the pack to a temperature at least as great, and preferably higher than the rolling temperature and then rapidly cooling to separate the foil from the steel. (P.G.C.)

52151 BERYLLIUM–ALUMINIUM COMPOSITE. (to Mallory Metallurgical Products Ltd.). British Patent 1,128,188. Sept. 25, 1968. Priority date Mar. 10, 1965, United States.

Composites of Al and Be, containing 50 to 90 wt % of Be, having high strength, good ductility, and low specific gravity are prepared by mixing the pressing Be and Al powders with an alkali or alkaline earth halogen, as LiF–LiCl, and sintering in Al at 800 to 1100°C for 1 hour. The action of the alkaline earth halide confines the Al within the Be, prevents expulsion of the Al from the sintered compact, and forms a composite of Be particles surrounded by an Al–Be matrix alloy. Density of the compacts may be increased by a double repress and an intermediate re-liquid phase sinter. (P.G.C.)

52152 VACUUM DISTILLATION OF YTTRIUM. Vorob'ev, V. V. Izv. Akad. Nauk SSSR, Metal., No. 4, 63-8(July-Aug. 1968). (In Russian).

The content of gaseous admixtures and carbon in distilled Y to a significant degree is determined by the pressure of residual gases which are in the vacuum chamber at the moment of distillation. Distillation in a vacuum chamber first pumped, degassed, and insulated from the diffusion pump yields high-purity Y relatively free from O_2, N_2, and C. The content of H_2 in the metal is determined by the partial pressure of H_2 in the chamber in the concluding stages of the distillation process. Increase of the temperature of the surface of the condensate to 1400°C decreases the total content of admixtures in the metal. (tr-auth)

52153 ELECTROCHEMICAL REFINING OF COMMERCIAL NIOBIUM IN CHLORIDE SALT MELTS. Suchkov, A. B.; Lobova, T. A.; Meerson, G. A.; Mikhina, V. N.; Safonov, V. V.; Korshunov, B. G. Izv. Akad. Nauk SSSR, Metal., No. 4, 52-5(July-Aug. 1968). (In Russian).

The possibility of the electrochemical refining of commercial Nb in chloride medium is established and the optimum technological parameters of the process are determined. The effect of the concentration of Nb in the electrolyte on the particle size of the cathode metal and of the length of electrolysis on the metal yield according to the current is investigated. From one electrolysis with generation of the anode material, more than 90% powdered Nb is obtained with the composition in wt %: 99.2 Nb, <0.30 Ta, 0.025 Ti, <0.01 Si, 0106 Ni, 0.02 C, 0.14 O. The microhardness of the grains of the fraction +0.4 mm is 67.0 to 69.0 kg/cm^2. At cathode current densities of 0.4 to 0.9 amp/cm^2 and electrolysis times not exceeding 1 hr, compact metal is obtained on the cathode. (tr-auth)

52154 QUALITY CONTROLS AND TECHNOLOGICAL DEVELOPMENTS OF MATERIALS FOR THE CONSTRUCTION OF NUCLEAR STEAM GENERATORS. Amato, Ignazio; Fox, Riccardo; Frigerio, Giovanni. Termotecnica (Milan), 22: 307-14 (July 1968). (In Italian).

A series of tests were made on the welding of stainless steel and Inconel tubes to tube plates using a semiautomatic device designed and constructed for this purpose. The stainless steel and Inconel pipes were for use in a PWR reactor. Spot welding tests on stainless steel were also carried out. Quality controls used in the welding are reported in some detail. (J.S.R.)

52155 ON SINTERING ABILITY OF POROUS BRIQUETTES MADE OF MOLYBDENUM FIBRE WITH SMALL ADDITIVES OF NICKEL. Sukhozhak, V. V.; Skorokhod, V. V. Porosh. Met., Akad. Nauk Ukr. SSR, No. 8, 23-5(Aug. 1968). (In Russian).

The results of experimental investigations of sintering molybdenum fibers with small additives of nickel are presented. The possibility is shown of activating the process of molybdenum fiber sintering by introducing a small quantity of nickel (up to 1% by weight). Nickel introduction sharply decreases the impact viscosity of the sintered fiber briquettes. (auth)

Properties Evaluations

Refer also to abstracts 51139, 51158, 51167, 51173, 51175, 51177, 51181, 52129, 52144, 52155, 52210–52213, 52226, and 53454.

52156 (AERE-Bib-151-A) COMPENDIUM OF REFERENCES TO STUDIES OF THE PROPERTIES OF LIQUID METAL BINARY SYSTEMS WHICH RELATE TO THEIR STRUCTURE. Mott, B. W. (Atomic Energy Research Establishment, Harwell (England)). July 1968. 47p. Dep. CFSTI. UK 7s. 0d.

A listing of 132 liquid metal binary systems is included in the bibliography. The physical properties of the binary system discussed are indicated for each listing. (J.C.W.)

52157 (AN-AGCR-880) CREEP-RUPTURE TESTS OF FINNED AND SMOOTH-WALLED HASTELLOY X PIN TUBING.

Fritzke, G. P. ([Aerojet-General Nucleonics, San Ramon, Calif.]). May 21, 1965. Contract AT(10-1)-880. 20p. (AN-MET-296). Dep. CFSTI.

A series of creep-rupture tests was performed with smooth-walled and finned Hastelloy X fuel pin tubing by internally pressurizing the tubing with argon in a furnace held at 2000, 2100, and 2200°F. From these tests, it was determined that both types of tubing can withstand the calculated conditions associated with a postulated loss-of-coolant (with simultaneous reactor scram) accident of the ML-1. It was also determined that the finned tubing fails at nearly the same stress/time exposure as smooth tubing and, therefore, it is concluded that the turbulence promoters on the finned tubing do not act as stress risers. A comparison is made between these test data and the stress-rupture life of Hastelloy X bar stock obtained from the literature. (auth)

52158 (APDA-226) GAS-WATER SIMULATION STUDIES OF SODIUM-WATER REACTIONS. Friedland, A. J.; Hagstrom, J. T.; Hori, M. (Atomic Power Development Associates, Inc., Detroit, Mich.). Sept. 1968. Contract AT(11-1)-865. 77p. Dep. CFSTI.

The early phases of an experimental and analytical program in which a simulation method for the investigation of the consequences of tube leaks in steam generators of sodium-cooled fast reactor power plants are described. With this method, pressurized gas released into water is used to simulate hydrogen generation in liquid sodium. A mathematical model, coordinated with the experiments, is used to predict results. It is planned to use the data as a basis for modifying the mathematical model and for determining the scaling laws applicable for modeling sodium–water reactions with gas injections into water. (auth)

52159 (CONF-671007-7) SERVICE AND EXPERIMENTAL EVALUATION OF CONDENSER TUBE AND TUBEPLATE MATERIALS FOR ESTUARINE AND SEA WATERS. Baker, D. W. C.; Davies, I.; Matthewman, W. (Central Electricity Generating Board (UK). South Eastern Region). [nd]. 37p. Dep.

From International Nickel Company Power Conference, Lausanne, Switzerland.

The factors influencing the locations of power stations in England and Wales result in the use of various sources of cooling water and different cooling systems. The characteristics of the more aggressive waters are discussed and common causes of condenser tube failure described. Service experience of established and experimental materials in operational condensers is considered and illustrated by reference to particular sites where serious problems have been encountered. The experimental facilities available within the Central Electricity Generating Board for the study of cooling water corrosion are described with particular reference to the Brighton Sea Water Corrosion Laboratory and to work on the evaluation of stainless steels. The results of an investigation of the possibility of condensate contamination by steam side corrosion of stainless steel condenser tubing under various operating conditions are reported. (auth)

52160 (EURAEC-2051) COMPARISON OF TEN LOW-ALLOY STEELS NORMALIZED AND TEMPERED FOR NUCLEAR REACTOR VESSELS. Final Report No. 1. Leymonie, C.; Bouverot, R.; Lochen, M.; Hennion, J. (Chantiers de l'Atlantique Saint-Nazaire (France)). Apr. 22, 1968. Contract 054-61-12-RDF. 90p. (EUR-3994). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

Ten steels were examined and compared, with a view to fabrication of nuclear reactor vessels. Research included transformation studies, measurement of mechanical properties after normalizing and tempering, study of stress relief, search for optimum conditions for stress relieving, and a study of overheating and possible recovery of overheated steel. It was found that some steels had a high elastic limit after normalizing and tempering (45 to 50 Hbar). One was selected for electro-slag welding tests. Various heat treatments for welded joints were tried with a view to improving the impact strength of the welds and of the heat affected zone. Under the test conditions heat treatments of the welded joints between A_c1 and A_c3 failed to produce the expected improvements, but impact strength was markedly improved by double normalizing. (P.G.C.)

52161 (N-68-23247) THE LESS COMMON REFRACTORY METALS: RHENIUM, HAFNIUM, TECHNETIUM, NOBLE METALS. Maltz, Joseph (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1967]. 34p. (CONF-680448-1; NASA-TM-X-61073). CFSTI.

From Symposium on the Metallurgy and Technology of Refractory Metal Alloys, Washington, D. C.

Previous reviews of the less-common refractory metals are cited and supplemented with discussions of newer developments. Special attention is given to the roles of hafnium–tantalum alloys and of iridium as oxidation-resistant coatings suitable for special situations. The physical metallurgy of technetium, which has only recently become available in sufficient amount for studies of that type, is another subject of attention. New data on phase equilibria, mechanical and physical properties, and availability are included. Insofar as the potential usage of these metals in applications which depend upon their high melting point is concerned, high cost and low availability preclude any radical changes in the near future. Instead, an orderly growth is indicated as research pinpoints the occasional unique benefits which can justify their very high cost. (auth)

52162 (ORNL-TM-2263) PHYSICAL AND MECHANICAL PROPERTIES OF TYPE 406 STAINLESS STEEL. McCoy, H. E. Jr. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 39p. Dep. CFSTI.

Several of the mechanical and physical properties of type 406 stainless steel were evaluated. The tensile properties were determined over the range 25 to 982°C and the creep-rupture properties were determined at 704, 816, and 927°C. Oxidation tests were run in air and flowing CO_2 over the temperature range 816 to 1371°C. The oxidation rates in air and CO_2 were equivalent. The thermal expansion was measured from 25 to 982°C. Structural changes during annealing and welding were noted. (auth)

52163 (ORO-3108-51) LATTICE DEFECTS IN QUENCHED NICKEL. Laidler, James Joseph (Virginia Univ., Charlottesville. School of Engineering and Applied Science). May 1968. Contract AT(40-1)-3108. 138p. Dep. CFSTI.

Thesis.

An experimental effort to observe quenched-in defects in Ni is described. High-purity polycrystalline nickel foils are quenched from a temperature near the melting point into liquid Ga and silicone diffusion pump fluid. The experimental apparatus and procedures are described in detail. Results are presented. (D.C.C.)

52164 (RFP-Trans-52) DIFFUSION IN THE PLUTONIUM–URANIUM SYSTEM. Dupuy, M.; Calais, D. Translated for Dow Chemical Co., Rocky Flats Div., [Golden], Colo.), from Mem. Sci. Rev. Met., 62: 721-32(1965). 25p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 20: 13313. (R.C.K.)

52165 THE PREDICTION OF COLLAPSE PRESSURES FOR ANISOTROPIC ZIRCALOY-2 TUBING USING TENSILE STRESS/STRAIN DATA. Slattery, G. F. (United Kingdom Atomic Energy Authority, Salwick, Eng.). J. Inst. Metals, 96: 267-73(Sept. 1968).

Instantaneous-collapse pressures of Zircaloy-2 tubing under a uniform external pressure were predicted from the stress/strain data using computer programmes. Good agreement was obtained with experiment for cold-worked and stress-relieved tubing where the elastic modulus was essentially the same in the circumferential and the axial direction. Annealing the tubing to recrystallize fully the worked structure produced a distinct anisotropy in the elastic modulus, such that the predicted results were lower than the experimental values. This anisotropy was associated with crystallographic textural changes in the Zircaloy. A safety criterion of 80% of the predicted collapse pressures was used to give safe working pressures for Zircaloy-2 tubing. (auth) (UK)

52166 MECHANISM OF CAVITY GROWTH DURING THERMAL CYCLING. Speight, M. V. (Central Electricity Generating Board, Berkeley, Eng.). J. Inst. Metals, 96: 265-7(Sept. 1968).

An expression is derived for the amount of cavity growth in U that can result from the effects of the internal stresses generated during cycling, and this mechanism is shown to account for the experimental measurements. (auth) (UK)

52167 DENSITY CHANGES IN URANIUM THERMALLY CYCLED BETWEEN 400 AND 600°C. Lobb, R. C. (Central Electricity Generating Board, Berkeley, Eng.); Sykes, E. C.; Johnson, R. H. J. Inst. Metals, 96: 262-5(Sept. 1968).

The growth of voids on thermally cycling uranium between 400 and 600°C was followed by means of a sensitive density-measuring technique. It was found that voids form in "adjusted" U, while very little porosity occurs in "pure" U similarly cycled. The majority of the voids lay on grain boundaries and their rate of growth was consistent with a concept of vacancy condensation on a fixed number of sites. (auth) (UK)

52168 STUDY OF STRESS-CORROSION CRACKING BY WEDGE-FORCE LOADING. Smith, H. R.; Piper, D. E.; Downey, F. K. (Boeing Co., Renton, Wash.). Eng. Fracture Mech., 1: 123-8(June 1968).

Traditional stress-corrosion tests involving smooth specimens are rapidly being replaced by tests derived from fracture mechanics. Although the opinion is widely held that stress-corrosion cracking (scc) is dependent upon an applied crack-tip stress-intensity factor, it can be argued that the dependency is with net-section stresses. Wedge-force loading a center cracked sheet specimen provides a unique resolution of the question. In this system, crack extension causes a decreasing stress-intensity factor at the crack tip, while at the same time, net-section stresses increase. Therefore, when stress-corrosion crack growth arrests in this specimen, the dependency on stress-intensity is proven. The stress-intensity at arrest is found to agree remarkably well with Kscc values determined by more conventional techniques wherein crack initiation thresholds are established by multiple tests. Crack growth rate data important to the establishment of inspection intervals in structure can also be obtained. The technique affords considerable economy of test time and material costs in stress-corrosion studies. (auth)

52169 FRACTURE ANALYSIS BY USE OF ACOUSTIC EMISSION. Dunegan, H. L.; Harris, D. O.; Tatro, C. A. (Univ. of California, Livermore). Eng. Fracture Mech., 1: 105-22(June 1968).

Results of acoustic emission studies are presented on flawed and unflawed specimens of aluminum and beryllium. Acoustic emission from the flawed specimens is found to begin at stress levels far below the general yield stress. A theoretical model given here indicates that the total number of acoustic emission signals from a specimen containing a crack should be proportional to the fourth power of the stress intensity factor obtained from a sharp-crack fracture mechanics analysis. This is in disagreement with experimental data from single-edge-notched fracture toughness specimens of the two materials, which indicate that acoustic emission varies more like the sixth to eighth power of the stress intensity factor. An example is given to show how the acoustic emission data obtained on fracture toughness specimens can be used to nondestructively test the fracture strength of an engineering structure. (auth)

52170 SUB-CRITICAL FLAW GROWTH. Johnson, Herbert H. (Cornell Univ., Ithaca, N. Y.); Paris, Paul C. Eng. Fracture Mech., 1: 1-45(June 1968).

The major evidence bearing upon sub-critical flaw growth in structural materials is reviewed and discussed. Attention is focused upon the growth of pre-existing flaws at operating stresses less than the net section yield strength from both the separate and combined effects of fatigue and aggressive environments. The applicability of fracture mechanics concepts to flaw growth is considered, and it is demonstrated that the stress intensity factor may be viewed as the driving force for both fatigue crack growth and environmental cracking under static load. This allows a correlation of test results from different specimen geometries, and also a correlation between test results and service failures. Cracking of steels and titanium alloys in various environments of water, water vapor, hydrogen, and oxygen are discussed. For steels, crack growth in water and saturated water vapor is a thermally activated process. The crack growth activation energy agrees well with the measured value for diffusion of hydrogen. The role of oxygen in inhibiting sub-critical flaw growth in vapor environments is discussed. It is shown that the stress intensity range is the major factor governing crack growth rates and fatigue life, with frequency and mean load as secondary variables. Crack growth rate laws are considered, and it is demonstrated that the fourth power law holds over the widest range. For steels, the fatigue crack growth rate is insensitive to composition, microstructure, and strength level, when the growth rate is plotted as a function of the stress intensity range. Environmental behavior patterns in static loading are observed to carry over to fatigue loading. A lack of data for stress intensity ranges less than the threshold is noted. Relationships among flaw size, threshold stress intensities in different environments, and proof and operating stresses are presented graphically and their interpretation is discussed. For 4340 steel, the role of yield strength level is summarized in a diagram which indicates that environmental cracking is the major problem at yield strengths in excess of 180 ksi, while fatigue crack growth is the major problem at lower strength levels. (auth)

52171 HYDROGEN FILLING OF NICKEL AND TITANIUM DUE TO THE IMPLANTATION OF 35 keV H^+ IONS. Katrich, N. P. At. Energ. (USSR), 25: 217-21(Sept. 1968). (In Russian).

A method for studying the migration of hydrogen implanted in metals at T = 78°K has been developed on the basis of different coefficients of hydrogen desorption from nickel and titanium. The depth distribution of the implanted hydrogen has been investigated. It is shown that the hydrogen filling of metals at low temperatures is not due to ordinary diffusion. In the implantation of 35-keV H_1^+ = ions, the accumulation of hydrogen starts first in a certain metal layer at a depth of the ion path. In this region the ultimate hydrogen concentration is achieved most quickly and this region extends with the further bombardment. The expansion rate is 1.35×10^{-9} cm/sec for the assigned current density j. The mechanism which causes the expansion may probably be related to the low activation energy for the diffusion of the small quantity of the loosely bound hydrogen. It is shown that the ultimate hydrogen concentration in nickel at T = 78°K is determined by the ratio: a hydrogen atom per a metal atom. The coefficient of sputtering the nickel film by 35-keV H_1^+ = ions is found. (auth)

52172 CATHODIC BEHAVIOR OF TITANIUM, ZIRCONIUM, AND NIOBIUM IN SOLUTIONS OF OXALIC ACID AND BENZALDEHYDE. Artemova, V. M. Elektrokhimiya, 3: 1219-21(Oct. 1967). (In Russian).

Polarographic curves were used to study the cathodic behavior of Ti, Zr, and Nb in H_2SO_4 solutions of oxalic acid and benzaldehyde. Ti and Nb were relatively inert toward benzaldehyde; Zr, however, in benzaldehyde solutions produced a substantial displacement of the potential in the positive direction. The polarographic curves for all three metals in oxalic acid solutions differed little from the corresponding curves in ordinary H_2SO_4. Mechanisms for these results are discussed. (D.H.M.)

52173 INFLUENCE OF CARBON-CONTAINING MEDIA ON THE STRUCTURE AND THERMAL EMF OF W–Re ALLOYS. Prokhorenko, V. Ya.; Terebukh, L. S.; Klym, N. M.; Slabkovskii, I. S.; Mykhal'chuk, V. I. (Lvov State Univ.). Fiz.-Khim. Mekh. Mater., 4: 369-71(1968). (In Russian).

Studies were made with thermoelectrode wire of 80 wt % W and 20 wt % Re (WR-20 alloy) and 95 wt % W and 5 wt % Re (WR-5 alloy). The curves of the temperature dependence of the absolute thermal emf of WR-20 and WR-5 alloys showed very little changes. Results of x ray studies of WR-20 thermal electrodes at 1 and 2 hr tests at 1500°C and 3 hr at 1000°C indicated shrinkage of the crystalline lattice parameters (Δa = 0.001, 0.011, 0.0146Å, respectively). One hour test at 1500°C results in more pronounced lattice shrinkage in WR-5 thermal electrodes. At much harder conditions the appearance of WO_3, WO_2, WC, and W_2C phases was due to the tungsten diffusion into the electrode surface followed by carbonization and oxidation. The new phases were confined to the γ surface of the electrode. The basic composition remained almost the same. (R.V.J.)

52174 SVOISTVA I PRIMENENIE ZHAROPROCHNYKH SPLAVOV. (Properties and Uses of High-Melting Alloys). Pridantsev, M. V. (ed.). Moscow, Izdatel'stvo Nauka, 1966. 300p.

The collection of articles includes information on aspects of experimental and theoretical work related to high-melting alloys. Information is included concerning problems of physico-chemical heat resistance of alloys, self diffusion in polycrystalline metals, deformation, and structure dislocation. Information is also included concerning the concepts of alloying high-melting metals and alloys, recrystallization parameters, and effects of polygonization. Information on nickel alloys is concerned with the creep of Ni and its alloys. The phase studies and thermal treatment of iron, chromium, and nickel are reviewed. Problems associated with kinetics and mechanism of formation of protective coatings on high-melting metals and alloys are reviewed. (R.V.J.)

52175 DETERMINATION OF THE MODULI OF ELASTICITY AND SHEAR AT TEMPERATURES UP TO 2000°C IN VACUUM AND INERT GAS ATMOSPHERE. Bugrov, V. A.; Grigorovich, V. K.; Kobylkin, A. N.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). Zavod. Lab., 34: 994-5(1968). (In Russian).

For the determination of the characteristics of elasticity, the radiotechnical resonance method was used. The installation, which permits measurements at frequencies of 20 to 200,000 gHz at temperatures up to 2000°C in vacuum at least 5×10^{-5} mm Hg, was developed. The modulus of elasticity of the alloy system uranium–zirconium–niobium was measured at temperatures up to 900°C and the concentration dependence of this alloy was constructed. (tr-auth)

52176 METHOD FOR THE HIGH-TEMPERATURE TESTING OF REFRACTORY METALS IN VACUUM. Getsov, L. B.; Kaprizov, V. A.; Simakovskii, A. P. Zavod. Lab., 34: 990-3 (1968). (In Russian).

A method for the brief and extended testing of metals in vacuum at temperatures up to 1800° is described. Data are given on the stability of the tungsten–rhenium thermocouple VR5/20. The effect of residual oxygen in the chamber on the composition, structure, and hardness of Mo and Nb samples during extended exposure is examined. Control tests of samples are reported with respect to the characteristics of the length stability and creep. (tr-auth)

52177 INFLUENCE OF CRYSTAL STRUCTURE AND SOME PROPERTIES OF HEXAGONAL METALS ON FRICTION AND ADHESION. Buckley, D. H.; Johnson, R. L. (Lewis Research Center, Cleveland). Wear, 11: 405-19(June 1968).

The adhesion, friction, and wear properties of single and polycrystalline metals are discussed. The influence of crystal structure, atomic plane, lattice parameter, and recrystallization on these properties is considered. In general, hexagonal metals exhibiting basal slip will have markedly lower adhesion, friction, and wear than bcc or fcc and non-basal slip hexagonal metals. Friction for hexagonal metals is highly anisotropic with the lowest friction coefficients being obtained on the preferred crystallographic slip planes when sliding in the preferred slip direction. For hexagonal metals, friction is also related to lattice parameters which influence the number of operating slip systems. Recrystallization alters the friction for both single and polycrystalline hexagonal metals. (auth)

52178 EFFECT OF NIOBIUM ON THE MECHANICAL PROPERTIES OF AN AUSTENITIC STAINLESS STEEL. Ray, S. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: No. 1, 13-17(Mar. 1968).

Effects of thermal treatment and cold rolling on the hardness and tensile properties at room temperature and at 700°C of an austenitic stainless steel containing 23% Cr, 19% Ni, 2.6% Nb and 0.04% C have been studied. It was found that double isothermal aging, 20 minutes at 850°C and 18 hours at 650°C, of samples water quenched from 1320°C gave maximum hardness and tensile properties. Cold rolling of the water quenched samples, before isothermal aging at 775°C for 20 hours, improved the mechanical properties. Improvement was observed up to 25% reduction in thickness and further reduction resulted in brittleness without a change in hardness. Structural examinations of the steel, using optical and electron microscopes, and x-ray diffraction of extracted phases were carried out. Hardening is attributed mainly to the precipitation of Fe_2Nb and NbC phases. Precipitation of M_6C, where M is metal, was also observed. (auth)

52179 TUNGSTEN NEWS, SEPTEMBER 1968. New York, Climax Molybdenum Co., 1968. 16p.

The development, properties, and uses of tungsten and tungsten alloys and compounds are reported. Industrial applications and new scientific data are discussed concerning the research in progress on tungsten and its alloys and compounds. The development of tungsten as an alloying metal is summarized. The mining and recovery procedures and the corresponding economics are discussed. A bibliography containing 162 references is included. (J.C.W.)

52180 CAVITATION PHENOMENA IN LIQUID METALS. Hammitt, F. G. Houille Blanche, 23: 31-5(1968).

The necessity to design high-temperature centrifugal pumps for sodium and sodium-potassium alloy of minimum size and weight for the aircraft nuclear power-plant project is discussed. It was evident that cavitation would impose limits on the possible miniaturization of the equipment. Liquid-metal cavitation received renewed interest in connection with the development of several types of space nuclear power plants (SNAP systems) for the production of electrical power aboard space vehicles. Some of these were to use liquid-metal Rankine cycles to convert the heat energy from a nuclear reactor to mechanical energy. As for the aircraft nuclear power plant, the miniaturization of the pumps associated with these Rankine cycles and with the reactor coolant circuits is limited by cavitation, and the questions cited above in connection with the aircraft nuclear plant are still pertinent. The problem was aggravated in SNAP, since long, unattended life was required. The liquid metals involved include mercury, sodium, potassium, and lithium. Liquid-metal cavitation in connection with sodium-cooled fast neutron breeder reactors is discussed. (App. Mech. Rev.)

52181 STRENGTHENING OF NIOBIUM AND ITS ALLOYS. Sokolova, G. V.; Mikhailov, S. K. Izv. Akad. Nauk SSSR, Metal., No. 4, 139-43(July-Aug. 1968). (In Russian).

Annealing in a vacuum $\sim 10^{-5}$ mm Hg is one of the methods of increasing the strength of Nb and its alloys at normal and high temperatures. For example, it is possible to increase significantly the long-term strength of Nb at 1000°C and of the Nb–1% Zr alloy at 1300°C. The hardening of Nb as a result of the annealing at 1500°C in vacuum can be connected with the increase of the gas absorption and the formation of oxide phases. (tr-auth)

52182 SUPERCONDUCTING SWITCH. Huebener, R. P.; Govednik, R. E. (Argonne National Lab., Ill.). Instrum. Technol., 15: 75(Aug. 1968).

The superconducting switch described and illustrated can separate the signal from the spurious voltage when thermocouple measurements are made in cryogenic applications, often difficult because of the relatively large spurious voltages generated in the thermocouple lead wires. These spurious voltages generally result from the large temperature difference between the thermocouple junction and the leads at the measuring device. The switch consists of 2 identical ferrite cores, a bobbin wound with Nb wire, and a Ta coil. The Nb coil and bobbin rest within the cores, and the Ta coil is wound noninductively in the air gap between the 2 cores. The switch is immersed in liquid He outside the vacuum can of the cryostat, and the Ta coil is shunted across the thermocouple in the can with short pieces of Nb wire. With no current in the Nb coil, the Ta wire is superconducting and shorts out the voltage generated by the thermocouple. In order that the measuring device will pick up only the spurious voltages, a small current in the Nb coil is used to create a magnetic field that breaks the superconducting property of the Ta coil, giving it a relatively high resistance. In this case the measuring device sees the sum of the 2 voltages. Combined by an accurate potentiometer, the switch will yield a sensitivity of 1×10^{-9} V. (BBB)

52183 FRACTURE TOUGHNESS OF BERYLLIUM. Harris, D. O.; Dunegan, H. L. (Univ. of California, Livermore). J. Mater., 3: 59-72(Mar. 1968).

Fracture toughness data are presented for varying thicknesses of two grades of Be; N50A which contains about 0.8% BeO, and S200 which contains about 2% BeO. Values of K_c (fracture toughness) for equivalent thicknesses of these two grades were about the same, with the lower purity S200 tending to show higher toughness. Thus, the more expensive, higher purity material offers no advantage when failure occurs by the catastrophic growth of preexisting flaws. The value of K_c varied with plate thickness even though all the fracture surfaces were completely flat, indicating that a flat fracture surface does not necessarily ensure that plane-strain conditions prevail. The agreement in K_c values of the N50A from batch-to-batch was good, but that between batches of S200 was poor. This was attributed to greater care during the fabrication of the higher grade N50A and indicated that considerable scatter from batch-to-batch can be expected in the fracture toughness of the lower grades of Be. The fracture toughness of Be is roughly comparable to that of the lower toughness alloys of Al. Thus the static load carrying capability of Be is comparable to that of the lower toughness Al alloys. (BBB)

52184 APPLICATIONS OF ZIRCONIUM, THE ATOMIC AGE METAL. Brady, W. R. (AMAX Specialty Metals, Inc., Akron, N. Y.). Mater. Protect., 7: 40-3(July 1968).

Use of Zr in nuclear and chemical equipment is reviewed after a discussion of the metal's physical and chemical properties. Zirconium is relatively transparent to thermal neutrons. This low thermal neutron cross-section and its excellent resistance to corrosion by steam and hot water have established Zr alloys as the accepted U fuel sheathing for the U. S. Naval Reactor Program and the commercial nuclear power industry. Commercial grade is basically pure Zr with up to 2% Hf. Hafnium, the companion element of Zr, is removed for nuclear applications but has no effect on the corrosion resistance. The Zircaloys were developed for use in water-cooled nuclear reactors. These alloys are characterized by good resistance to hot water and steam to about 371°C, but they are more prone to general corrosion in chemical environments than unalloyed metal. A table gives composition of some of the alloys. Zirconium derives its excellent corrosion resistance from a tenacious, inert oxide film that forms on the metal's surface. The strength of this passive film is typified by general resistance of Zr to most reducing media, most oxidizing media (if chlorides are not present), strong basic solutions, and fused alkalis. (BBB)

52185 REVIEW OF TEXTURE STRENGTHENING OF TITANIUM ALLOYS. Babel, H. W.; Frederick, S. F. (Douglas Aircraft Co., Santa Monica, Calif.). J. Metals, 20: No. 10, 32-8 (Oct. 1968).

Tests for texture strengthening include direct and indirect techniques which utilize measurement of some other property that can be related to biaxial strength. Direct methods include cylindrical pressure-vessel tests, tests of uniaxially loaded specimens that produce plane-strain tension, plane-strain compression, and thickness compression. Experimental results are included for alloys of Ti–Al–V, Ti–Al–Sn, Ti–Al–O_2, and Ti–Al–Mo–V. (J.C.W.)

52186 PROPERTY OF ZIRCONIUM ALLOY SYSTEM Zr–Ta–V. Tararaeva, E. M.; Ivanov, O. S. Izv. Akad. Nauk SSSR, Metal., No. 4, 170-9(July-Aug. 1968). (In Russian).

The corrosion properties of the alloy of the Zr angle, located on the radial cross section Ta : V = 1 : 3, 1 : 1, and 3 : 1 with total content of alloying elements from 0.2 to 10.0 wt %, are investigated by the methods of periodic weighing, microscopic analysis, measurement of the thickness of the oxide layer, and measurement of the depth of penetration of gases (by the method of the measurement of the microhardness on the sample cross section). With

respect to the stability against oxidation in CO_2 at 500°C and 60 atm during 10,000 hrs, the alloys with 0.8 to 1.0% Ta and V distributed on the cross section Ta : V = 1 : 3 and 1 : 1 have a higher stability than unalloyed Zr. With respect to the corrosion properties in water at 400°C and 170 atm during the course of 9000 hrs, the alloys with 0.2 to 1.2% Ta and V and with predominant content of V appear better. The most stable against oxidation in air at 650°C for 150 hrs are slightly alloyed alloys with V as the principal constituent. The experimental data suggest that small additions of V in combination with very small additions of Ta increase the corrosion stability of Zr in different media. The mechanical properties of the alloys distributed on the cross section Ta : V = 1 : 3, 1 : 1, and 3 : 1, with total content of alloying element from 0.2 to 10.0 wt %, are investigated. The investigation of the properties of the alloy during tension shows that V and Ta are very effective strengthening additions for Zr both at room temperature and at 400°C. The study of the creep of the alloys at 400, 500, 600, and 700°C shows that the common alloying of Zr with Ta and V up to 5 wt % decreases by 10 times the rate of alloy creep. (tr-auth)

52187 SOLUBILITY OF HYDROGEN IN LIQUID NIOBIUM. Kalinyuk, N. N.; Lakomskii, V. I. Izv. Akad. Nauk SSSR, Metal., No. 4, 28-32(July-Aug. 1968). (In Russian).

The solubility of H_2 in liquid Nb is studied by tempering methods in four temperature groups in the interval from 2600 to 2820°C at partial pressure of H_2 from 7 to 62 mm Hg. The samples are fused in suspension in an electromagnetic field. The equilibrium in the system liquid Nb–H_2 is established simultaneously with thermal equilibrium and the system follows the Siverts rule at all pressures and temperatures studied. The temperature dependence of the solubility of H_2 at atmospheric pressure of H_2 is described by the equation $\lg S_{760} = 1620/T + 1.583$ (2600°C < T < 2820°C). The heat of solution of H_2 in liquid Nb is 14,800 cal/g-mol of H_2. In the temperature range from 2660 to 2690°C an abnormally low solubility of H_2 in liquid Nb is observed, and it does not obey the temperature dependence. It is assumed that the observed deviation from the general regularity is caused by changes in the properties of the liquid metal. At the melting point the solubility of H_2 in liquid Nb is 2 to 2.5 times higher than in the solid Nb. (tr-auth)

52188 CREEP CRACKS AND THE CONCEPT OF DAMAGE. Lindborg, U. (Aktiebolaget Atomenergi, Stockholm). J. Mech. Phys. Solids, 16: 323-8(Sept. 1968).

Mechanisms for creep damage and fracture were analyzed and compared with phenomenological creep rupture theories for an austenitic stainless steel. The most common form of damage in this material appeared to be the formation of sharp grain boundary cracks. A model has been proposed for the gradual growth of one of these cracks to infinite size. The size of this crack should represent the extent of damage in the material when widespread crack coalescence does not take place. The model is consistent with the Kachanov-Odqvist theory for creep rupture and, under certain conditions, with the Robinson life-fraction rule for the summation of creep periods of different stress levels. Ductile creep theories appear to be applicable only in rare cases for these materials. (auth) (UK)

52189 MECHANICAL BEHAVIOR OF REFRACTORY-METAL ALLOYS. Schmidt, Fritz, F.; Bartlett, Edwin S. (Battelle Memorial Inst., Columbus, Ohio). Metal Treat., 18: 12-14; 16; 18-21 (Aug.-Sept. 1967).

Alloying of the refractory metals to improve high-temperature strength without reducing low-temperature ductility resulted in the development of commercial alloys with greatly improved mechanical behavior. The alloys are consolidated by consumable-electrode, electron beam or arc melting processes, or, for W, by powder compaction and sintering. Primary fabrication is usually by hot extrusion, although Nb- and Ta-base materials can be forged directly from the ingot stage. Fabrication to finished mill products is by conventional techniques from 2500°F to room temperature, with stress relief anneals and intermediate conditioning, as required. Tensile strength from 2000 to 4500°F and low-temperature ductility data are given for various Nb, Ta, Mo, and W alloys. Graphs are used to show the effects of alloy additions on these properties and rupture strength. (Rev. Metal. Lit.)

52190 THERMODYNAMIC PROPERTIES OF URANIUM–ZIRCONIUM ALLOYS. Fedorov, G. B.; Smirnov, E. A. At. Energ. (USSR), 25: 54-6(July 1968). (In Russian).

Thermodynamic properties of U–Zr systems at room-temperature to 1000°C were studied using specimens of 99.78% pure U and iodide Zr prepared by arc melting. Specimens of pure U and Zr and alloys containing 11, 27, 39, 59, and 87 wt % U were tested. (R.V.J.)

52191 MATERIALS SELECTION IN THE POWER INDUSTRY. Johnson, Donald R. (Bechtel Corp., San Francisco, Calif.). pp 199-216 of Methods of Materials Selection. Verink, Ellis D. Jr. (ed.). New York, Gordon and Breach, Science Publishers, Dec. 1966.

From 1st Symposium on Methods of Materials Selection, Gainesville, Fla. See CONF-660577.

Materials selection for conventional fossil-fueled steam power plants is discussed. A typical example, high temperature-high pressure main steam piping, has been chosen to illustrate the effect of mechanical properties and requirements for fabrication, welding, inspection, and testing on materials selection. (auth)

52192 METHODS OF MATERIALS SELECTION IN THE NUCLEAR INDUSTRY. Horton, Kenneth E. (Division of Reactor Development and Technology, Washington, D. C.). pp 239-66 of Methods of Materials Selection. Verink, Ellis D. Jr. (ed.). New York, Gordon and Breach, Science Publishers, Dec. 1966.

From 1st Symposium on Methods of Materials Selection, Gainesville, Fla. See CONF-660577.

Design data such as thermal conductivity, thermal expansion coefficient, low-cycle fatigue and impact resistances, creep strength and ductility and metallurgical stability are required for reactor. The unique feature presented by anticipated reactor application, however, is that these properties must usually be known during and after irradiation. The irradiation effect is not linear — requiring an initial dose before a noticeable property degradation. Furthermore, it is often found that a synergism exists between dose and temperature and thus extrapolation is made difficult, if not risky. A detailed analysis is required for a material decision, with property trade offs frequently necessary. The availability of data gathered under more severe test conditions than those anticipated is desirable. (auth)

52193 INVESTIGATION OF SINTERING THE MIXTURES OF NICKEL AND MOLYBDENUM POWDERS. Sleptsova, N. P.; Solonin, S. M.; Chernyshev, L. I. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, 69: No. 9, 39-45(Sept. 1968). (In Russian).

Sintering kinetics of mixtures of Mo powders and carbonyl Ni (to 35% of Mo) are investigated. It is shown that powder alloys Ni–Mo are homogeneous after sintering during 1 to 2 hr at 1473°K. The electric resistance durability and microstructure of the alloys Ni–Mo are studied. (auth)

52194 SPECTRAL RADIATION EMISSION OF Mo, Ta, Nb, AND Tr IN THE INFRARED REGION. Dmitriev, V. D.; Kholopov, G. K. Teplofiz. Vys. Temp., 6: 550-1(May-June 1968). (In Russian).

Graphical results are given on the measurement of radiation emission of Mo, Ta, Nb, and Zr in the spectral range from 1 to 5 μ at 1427, 1423, 1433, and 1422°K, respectively. Tabulated data indicate that the transition from the luminous to the true temperature was calculated with the order of accuracy of ±5°K. (R.V.J.)

52195 INTEGRAL SEMISPHERICAL RADIATION EMISSION AND SPECIFIC ELECTRIC RESISTANCE OF Ta AT TEMPERATURE FROM 1200 TO 2800°K. Petrov, V. A.; Chekhovskoi, V. Ya.; Sheindlin, A. E. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp., 6: 548-9(May-June 1968). (In Russian).

Obtained tabulated data on integral semispherical radiation emission and specific electric resistance of tantalum at 1200 to 2800°K temperature were in good agreement with published data. The maximum divergence was found at 1500°K where the order of discrepancy was only 2% and at 1800 to 2800°K where it was 3%. (R.V.J.)

Structure and Phase Studies

Refer also to abstracts 52174 and 52177.

52196 (AECL-2715) MICROPROBE DETERMINATION OF THE $\alpha/(\alpha + \beta)$ BOUNDARY FOR THE Zr–Nb SYSTEM. Bethune, I. T.; Williams, C. D. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). July 1968. 16p. Dep. CFSTI. CAN $0.50.

Electron probe microanalysis has been used to locate the position of the $\alpha/(\alpha + \beta)$ boundary in the Zr–Nb phase diagram by measuring the phase compositions in specimens of a Zr–2.5 wt % Nb–0.12 wt % O alloy annealed at 600 to 850°C. The solubility of Nb in α-Zr at 600°C is shown to be 1.1 ± 0.1 wt %. The concentration of Nb in the α-phase annealed for short intervals at 850°C is also close to 1%, decreasing to 0.85 ± 0.05 wt % with prolonged annealing at this temperature. A precise determination of the $(\alpha + \beta)/\beta$ boundary has not been made; extrapolation of non-equilibrium compositions indicate that the monotectoid composition is close to 20 wt % Nb, as shown in earlier phase diagram work. (auth)

52197 (BNWL–402) STUDY OF PHASE EQUILIBRIA WITH PLUTONIUM–ZIRCONIUM ALLOYS. Taylor, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 29p. Dep. CFSTI.

A partial Pu-Zr equilibrium diagram is presented which confirms the existence of a solid solution intermetallic zeta phase. The diagram developed differs from the equilibrium diagrams previously published. The effect of cooling rate on the retention of high temperature phases at room temperature is discussed along with heat treatments required to homogenize the Pu-Zr alloys. The stability of retained beta phase Pu with respect to temperature, pressure, and time is also presented. (auth)

52198 (CEA-R-3494) X-RAY TOPOGRAPHY OF URANIUM ALLOYS. Le Naour, Lucien (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1968. 52p. (In French). Dep.

A description of the structure of uranium alloys has been made using the data obtained by x-ray diffraction techniques derived from the Berg-Barrett method. In the first stage the use of a monochromatic beam of x rays having a very low divergence makes it possible to obtain very reproducible and exact numerical data concerning the grain and sub-grain sizes, and also the distribution of the sizes. It is thereby possible to detect any disorientation greater than 30 seconds of arc. The results obtained have been completed using a variable incidence device which gives simultaneously an overall picture of a grain and an idea of the importance of internal disorientations; a more rigorous measurement of this latter parameter is then deduced from the DEBYE–SHERRER diagrams obtained using a fine-focus equipment. Observations are carried out on various one-phase or two-phase uranium alloys which are compared successively to technical and to high-purity uranium. It is shown that the use of x-ray topographies, although limited in certain respects, allows a quantitative characterization of the structure. (auth)

52199 (COO–1431-4) EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED fcc METALS AND ALLOYS. Technical Progress Report No. 4, September 1, 1967–September 1, 1968. Mikkola, D. E.; Borich, D. J.; Kirby, J. W.; Sakai, M.; Ward, A. L. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). Contract AT(11-1)-1431. 33p. Dep. CFSTI.

The effects of annealing on the substructure of cold worked fcc metals and alloys are analyzed. The changes in substructure are related to physical properties. Materials studied are Cu–Ge alloys and Cu_3Au. X-ray line broadening and peak shifts are used to examine the substructure. Direct observation by transmission electron microscopy is used to allow a comparison of the substructure in bulk with thin foil specimens. (auth)

52200 (DP–1138) DIRECTIONAL STRAIN AND HYDRIDE ORIENTATION IN ZIRCALOY. Marshall, Robert P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Oct. 1968. Contract AT(07-2)-1. 27p. Dep. CFSTI.

A refined "Directional Strain Parameter" (DεP-II) was developed to explain the hydride orientation in seamless Zircaloy tubing on the basis of laboratory and commercial fabrication histories. The directional strain (or fabrication) history, expressed as DεP-II, explained 93% of the observed variations in hydride orientation in the tubing. The grain size of the tubing had a marginal effect on the hydride orientation, and the location of the hydride platelets, transgranular or intergranular, was not significant in controlling the orientation. (auth)

52201 THE α (C.P.H.) $\rightleftharpoons$ β (B.C.C.) EQUILIBRIUM IN TITANIUM AND ZIRCONIUM ALLOYS. Hume-Rothery, W. (Oxford Univ.). Progr. Mater. Sci., 13: 258-9(1967).

In Ti and Zr the α- or close-packed hexagonal structures are stable at low temperatures, and transform at higher temperatures into β-Ti or β-Zr, which are bcc and are stable up to the melting points. Transition metals to the right of Group IVA in the Periodic Table, and also Cu, Ag, and Au, lower the transition temperatures and favor the bcc structures. Yttrium, which lies to the left of zirconium in the Periodic Table, has the reverse effect, raising the transition temperature of Zr, and favoring the cph structure, and this is also the case with most non-transition metals when dissolved in Ti or Zr (e.g., Al and Sn in Ti and Zr). This is discussed in terms of the Engel-Brewer theory of metals and alloys. (auth) (UK)

52202 INVESTIGATION OF THE SYSTEM Ta–V–Nb. Eremenko, V. N.; Komarova, S. A.; Tret'yachenko, L. A. Izv. Akad. Nauk SSSR, Metal., No. 4, 180-2(July-Aug. 1968). (In Russian).

The high-temperature part of the equilibrium diagram of the Ta–V–Nb system is investigated. The inorganic mutual solubility of the components at 1750°C is found. The projection of the solidus surface of the ternary Ta–V–Nb system is constructed and the solidus lines of the binary Ta–Nb system are determined. The lattice periods and microhardness of the Ta–V–Nb alloy, tempered at 1750°C, are measured. (tr-auth)

52203 INVESTIGATION OF THE EQUILIBRIUM AND PROPERTIES OF THE ALLOY Ti–Zr–Al. Shirokova, N. I.; Nartova, T. T.; Kornilov, I. I. Izv. Akad. Nauk SSSR, Metal., No. 4, 183-7(July-Aug. 1968). (In Russian).

The interaction of the metallide Ti_3Al with the solid solution of Ti with 5% Zr in the alloy, prepared by the method of fusion in an arc furnace in an atmosphere of He and melted in suspension is studied. The polythermal cross section of Ti_3Al–(Ti + 5% Zr) of the ternary system Ti–Zr–Al is constructed and the phase limits of this part of the equilibrium diagram are established with consideration of the aluminide Ti_3Al in the Ti–Al system. The interaction of Ti with Zr and Al in the ternary system Ti–Zr–Al in the cross section studied is analogous to the interaction of Ti with Al in the binary system Ti–Al. The established character of the chemical interaction of the components of the cross section studied of the ternary system is confirmed by studies of the microstructure and the properties (electric resistance and hardness) as a function of the composition. (tr-auth)

52204 PHASE DIAGRAM OF THE SYSTEM Zr–Mo–Nb IN THE SOLID-STATE REGION. Svechnikov, V. N.; Spektor, A. Ts. Izv. Akad. Nauk SSSR, Metal., No. 4, 188-93(July-Aug. 1968). (In Russian).

The isothermal profiles of the ternary system Zr–Mo–Nb are constructed at 600, 800, 1100, 1350, and 1600°C, including all concentration triangles, and the pattern of the solubility boundary $\gamma(\beta)/\gamma(\beta) + \epsilon$ is determined at 1800°C. It is shown that the solubility boundary $\gamma(\beta)/\gamma(\beta) + \epsilon$ with increase of the temperature over 1100°C is displaced from the Nb–Zr side to high contents of Mo. The data confirm previous results on the position of the solubility boundary at 1400°C. According to the present data, the solubility boundary at 1800°C terminates at Mo concentration ~40%. The existence in the solid state range of eutectoid conversions at the temperature of ~550°C is established. (tr-auth)

52205 PENETRATION AND CAPTURE OF LOW-ENERGY INERT GAS IONS IN POLYCRYSTALLINE TUNGSTEN. Erents, K.; Carter, G. (Univ. of Liverpool). J. Phys., D, 1: 1323-9 (Oct. 1968).

Experimental values of the trapping probability of low-energy inert gas ions in polycrystalline tungsten are presented. This trapping probability is shown to be critically dependent upon the surface topography and the defect state of the tungsten, and it is concluded that experimental data determined without proper regard for these variables cannot be used for informative comparison with theoretically determined values of trapping probability. A theoretical model accounting for the possible relaxation of the tungsten lattice during ion penetration is also presented. (auth) (UK)

52206 NUCLEATION AND GROWTH OF MULTI-LAYER DEFECTS IN QUENCHED ALUMINIUM. Bacon, D. J.; Bullough, R. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 18: 561-71(Sept. 1968).

Edington and West (Phil. Mag., 15: 229(1967)) observed four-layer defects in quenched aluminum in which the inner vacancy loop had apparently nucleated and grown inside a perfect (unfaulted) loop. This observation precludes the vacancy–stacking fault interaction as a cause of such inner loop formation and also suggests that the nucleation and growth of such loops in faulted regions (the inner loops in two and three-layer structures) probably occurred for reasons other than the vacancy–stacking fault interaction. Bullough and Hardy (Phil. Mag., 17: 833(1968)) made a discrete lattice estimate of the effective (continuum) dilatation associated with a vacancy in aluminum. This value is used to calculate the size effect and inhomogeneity interactions between a small dislocation loop and a vacancy. The results suggest that nucleation of a loop inside another small loop is possible without invoking a vacancy–stacking-fault interaction, and once such nucleation has been achieved subsequent growth of the inner loop should take place at a later stage. (auth) (UK)

52207 PHASE TRANSFORMATIONS IN CERIUM. Amonenko, V. M.; Pavlov, V. S. Izv. Akad. Nauk SSSR, Metal., No. 4, 206-8(July-Aug. 1968). (In Russian).

An installation for the differential thermal analysis is described. The installation makes it possible to study the transformations in metals and alloys with low heating rate of the sample. Differential thermal analysis is carried out on two types of cerium. It is shown that on purified metal only two thermal effects are observed: the $\gamma \rightleftharpoons \delta$ transformation at 727°C and fusion at 804°C. The effect, observed in the temperature interval from 600 to 700°C on the impure metal, is connected with the presence of impurities. (tr-auth)

52208 OBSERVATIONS ON MECHANICAL TWINNING IN GADOLINIUM. Srivastava, O. N.; Kumar, J. (Banaras Hindu Univ., India). Phys. Lett., 27A: 675-6(Oct. 7, 1968).

Mechanical twinning in gadolinium has been observed by using an electron microscope. The twinning elements are determined by selected area diffraction; these are, $\kappa_1 = \kappa_2 = (10\bar{1}2)$, $\eta_1 = \eta_2 = [10\bar{1}1]$. This communication describes the origin and growth of these twins, since so far no observation of twinning in gadolinium seems to have been reported. (auth)

52209 PARTICLE GROWTH DURING TUNGSTEN AND MOLYBDENUM REDUCTION AND ACTIVATION OF SINTERING THESE METALS. Savin, A. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR, 69: No. 9, 34-8(Sept. 1968). (In Russian).

Particle growth during the reduction and kinetics of shrinkage of tungsten and molybdenum powders depend on simultaneous processes such as partial melting and sublimation of dioxide surface layers on these metals. During the high temperature (>1100°C) reduction fine particles of tungsten and molybdenum dioxides are sublimated and precipitated on greater ones; on the surface of the particles the liquid phase may arise, that results in the appearance of capillary forces cohering the separate particles. The melting of the oxides covering the surface of metal particles of tungsten and molybdenum favors the shrinkage during sintering and sublimation of the oxides and the reverse inhibits the shrinkage of these metals. (auth)

Radiation Effects

Refer also to abstracts 51147, 52139, 52850, 52874, 53401–53403, and 53456.

52210 (BNWL-844) EFFECT OF HYDROSTATIC PRESSURE ON THE RECOVERY OF ELECTRICAL PROPERTIES OF IRRADIATED MOLYBDENUM. Kulcinski, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1968. Contract AT(45-1)-1830. 36p. Dep. CFSTI.

High purity Mo has been irradiated at 40°C to 6.2×10^{18} n/cm^2 (E > 1 MeV) and subsequently isochronally annealed at two pressures, ≤1 bar and 20,000 bars. The electrical resistance increase recovers in three stages at low pressure, 150°C, 425°C, and 575°C. The activation energy for the 150°C recovery peak is 1.25 ± 0.09 eV and the order of the reaction varies from 3.4 at 135°C to 1.7 at 164°C. The effect of pressure is to lower the 150°C recovery peak to 90°C; this shift implies a negative activation volume of migration of −0.9 molar volumes for the migrating defect. The final recovery peak is lowered to 375°C under pressure and displays a pressure coefficient of −10°C/kbar. The 425°C peak is apparently also lowered by pressure, but because of its small magnitude and uncertainty in its position, more detailed data are required for analysis. (auth)

52211 (BNWL-845) THE EFFECT OF HYDROSTATIC PRESSURE ON THE RECOVERY OF UNIT CELL DIMENSIONS IN IRRADIATED MOLYBDENUM. Kulcinski, G. L.; Kissinger, H. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 17p. Dep. CFSTI.

Irradiation of high purity Mo to 6.2×10^{18} n/cm^2 (E > 1 MeV) at 40°C results in a 0.22% lattice parameter increase. Isochronal anneals at ≤1 bar disclose that the expansion of the material recovers in three stages, 150, 400, and 750°C. Combination of this data with previously obtained electrical resistance measurements reveals that there are four recovery stages above room temperature. The designation of recovery stages has been modified: stage III (150°C), stage IV-A (400 to 425°C), stage IV-B (575°C), and stage V (750°C). Because isochronal anneals at 20,000 bars of hydrostatic pressure lower stage III to 90°C, a negative activation volume of migration is implied. The temperature for complete recovery of lattice parameter is lowered by pressure from 750°C to 350°C. Analysis of the data implies a divacancy mechanism for stage III recovery. (11 references) (auth)

52212 (BNWL-846) HYDROSTATIC PRESSURE INDUCED ANNEALING OF DEFECT CLUSTERS IN IRRADIATED MOLYBDENUM. Kulcinski, G. L.; Mastel, B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 28p. Dep. CFSTI.

Irradiation of high purity Mo to 6.2×10^{18} n/cm^2 (E > 1 MeV) at 40°C produces 3.7×10^{16} observable defect clusters/cc. The average cluster diameter is 25 to 35 Å. Postirradiation annealing at ≤1 bar causes the cluster density to decrease during stage III (150°C), increase during stage IV-A (400°C) and decrease to zero during final recovery at stage V (750°C). Isochronal recovery under 20 kbars of hydrostatic pressure shows that stage III is lowered to 90°C and stage V to 450°C. The recovery stages are compared to those obtained from previous electrical resistance and lattice parameter studies to establish a tentative model for radiation damage annealing in molybdenum. (auth)

52213 (BNWL-847) EFFECT OF HYDROSTATIC PRESSURE ON THE RECOVERY OF IRRADIATION INDUCED HARDNESS IN MOLYBDENUM. Kulcinski, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 14p. Dep. CFSTI.

Irradiation of high purity Mo at ~40°C to 6.2×10^{18} n/cm^2 (E > 1 MeV) induces a 19% increase in the Vickers hardness of the metal. Post-irradiation isochronal annealing at ≤1 bar results in a steady increase in the hardness which reaches 26% at 600°C. The hardness increase recovers over the 600 to 1000°C temperature range and returns to the unirradiated value at 1000°C. Isochronal anneals at 25°C and 20 kbars results in a 40% increase in the hardness over the as-irradiated value. High pressure anneals in the 80 to 400°C range do not significantly change the hardness while in the 400 to 500°C range rapid recovery occurs. The recovery of irradiation induced hardness appears to be related, in a very complex manner, to the recovery of observable defect clusters. The annealing of electrical resistance, lattice parameter, defect cluster density, and hardness increases are compared and discussed. (9 references) (auth)

52214 (BNWL-SA-1768(Rev.)) DEVELOPMENT OF VOIDS IN NICKEL DURING IRRADIATION. Mastel, B.; Brimhall, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 20, 1968. Contract AT(45-1)-1830. 8p. (CONF-680905-2). Dep. CFSTI.

From 26th Annual Meeting of the Electron Microscopy Society of America, New Orleans, La.

Disks of high-purity Ni foil were annealed at 700°C for 1 hr in vacuum, cooled slowly, and irradiated at a constant temperature of 380°C after surrounding with a NaK mixture. Other disks were irradiated in He filled capsules at 400 to 450°C. Total neutron fluences for the two capsules were 5×10^{19} n/cm^2 and 4×10^{19} n/cm^2 (E > 1 MeV) respectively. Pores similar in size and shape were observed in both irradiated specimens, and determined to lie within the foil, but were absent in unirradiated control specimens. The pores, although not cubic, had definite geometric shapes, possibly octahedral. It is postulated that the pores did not develop from gas bubbles but were essentially empty pores, or voids, formed by coalesence of vacancies produced by displaced atoms. Annealing at 700°C for 2 hrs produced an inhomogeneous distribution of voids, and at annealing for 2 hrs at 800°C the voids disappeared. (P.G.C.)

52215 (SLAC-Trans-86) STUDY OF ELECTRON-INDUCED DESORPTION FROM THE SURFACE OF METALS. Vakhrushin, Yu. P.; Ryabov, V. V. (Electro-Physical Apparatus Scientific Research Inst., Leningrad (USSR)). Translated for Stanford Linear Accelerator Center, Calif., from Russian report. 11p. Dep. CFSTI.

The electrodesorption of gases from the surface of Ti and Ni is studied. Vacuum properties of Ni and Ti at 10^{-8} to 10^{-7} torr are presented. A comparison of gas electrodesorption from stainless steel, Ti, and Ni is also presented. (D.C.C.)

52216 INVESTIGATIONS OF TEST FUEL ELEMENTS IN THE HOT LABORATORY OF SIEMENS. Knaab, H.; Spang, A. (Siemens-Schuckertwerke, AG, Erlangen, Ger.). Atomwirt., Atomtech., 13: 438-40(Aug.-Sept. 1968). (In German).

Post-irradiation investigations in hot cells are of importance, particularly for industrial firms which develop and supply the reactors and fuel elements. The operation of a hot laboratory with two cells shielded with 90 cm of heavy concrete and eight cells with lead shielding is described. First, the irradiated fuel elements are visually inspected and their condition compared with that before irradiation. The dimensional testing is particularly comprehensive since it supplies important information about the mechanical stability of a fuel element and about the joint operation of the fuel rod components. The relative burn-up along the length of a fuel rod is determined by measuring the gamma activity of the fission products. The integrity of the canning tube is investigated by gas sampling to determine the liberated fission gas and by testing for leaks. The ^{235}U burnup and the fast neutron dose are determined by radiochemical processes. Structure investigations on the canning materials and on the fuel are carried out in the lead cells. The distribution of fission products and, more recently, that of the plutonium are also investigated by autoradiographic tests. (auth)

52217 EFFECT OF HIGH TEMPERATURE NEUTRON IRRADIATION ON MECHANICAL PROPERTIES AND COLD BRITTLENESS OF SINGLE AND POLYCRYSTALLINE MOLYBDENUM. Nikolaev, V. A.; Patrikeev, Yu. I.; Mikhailov, S. K. At. Energ. (USSR), 25: 197-200(Sept. 1968). (In Russian).

The effects of neutron irradiation on mechanical properties of single and polycrystalline Mo with different content of induced impurities have been investigated by tensile tests at temperatures of −60 to 300°C and by measuring hardness. The specimens were irradiated by an integral dose of ~10^{19} n/cm² (E > 1 MeV) at temperatures of 800−1000°C, 1400−1500°C, and 150°C. Irradiation of single crystalline Mo specimens resulted in increasing the yield stress and hardness and the temperature of cold brittleness by 20−60°C. Irradiation of polycrystalline Mo at the temperature of 800−1000°C produced a small effect on its mechanical properties, but increased the temperature of cold brittleness by 15−30°C. (auth)

52218 INFLUENCE OF NEUTRON IRRADIATION, HEAT TREATMENT, AND DEFORMATION ON THE MARTENSITIC TRANSFORMATIONS IN METASTABLE β-BRASS. Hummel, R. E.; Koger, J. W. (Univ. of Florida, Gainesville). Scr. Met., 2: 403-4(July 1968).

Results of studies are reported on metastable, ordered β_1−Cu−Zn alloys at low-temperatures include resistance and x-ray measurements. Low-temperature electron micrographs of the diffusionless transformation of β_1-brass to low-temperature martensite and electron micrographs of β_1-brass stressed in tension in the microscope are presented. Metastable β_1−Cu−Zn (38.3 to 39.4 wt % Zn) was studied to determine the effect of repeated thermal cycling, deformation, annealing, bombardment with fast neutrons, and the presence of untransformable phases on these transformations. The principal characteristics of the transformation on cooling (from resistance measurements) were the M_s temperature, the temperature coefficient of electrical resistivity of the phase, area of the hysteresis loops of the (percent) transformation curve, and rate of transformation. The M_s temperature changed according to the treatment given. Elastic deformation and presence of retained martensite raised M_s. It was lowered after plastic deformation and neutron irradiation but was not affected by heat up to 100°C. Neutron doses from 5 × 10^{15} to 5 × 10^{18} n/cm² (E > 1 MeV) decreased the martensitic-start temperature (M_s) up to 8°C and increased the maximum rate of transformation. M_s was further decreased when β_1-brass was annealed at 150°C after irradiation. After irradiation with fast neutrons no increase in the area of the hysteresis loop was detected, showing that the irradiation-induced defects were only small disturbances. (BBB)

52219 LENGTH AND ELECTRICAL RESISTIVITY CHANGES OF NEUTRON IRRADIATED URANIUM. Loomis, B. A.; Gerber, S. B. (Argonne National Lab., Ill.). Phil. Mag., 18: 539-53 (Sept. 1968).

The length change of uranium single crystals in the [100], [010], and [001] crystallographic directions was determined during thermal neutron irradiation at temperatures between 5 and 550°K. The electrical resistivity induced in uranium single crystals during neutron irradiation at temperatures between 4.5 and 20°K was also determined. The recovery of the irradiation-induced electrical resistivity and length changes was correlated with the temperature dependence of the irradiation-induced length changes. These results are consistent with the hypothesis that elongation in the [010] direction and contraction in the [100] direction during thermal neutron irradiation of uranium single crystals are due to the anisotropic condensation of vacancy and interstitial defects in planar clusters. The substantial decrease in magnitude of the length changes on increasing the irradiation temperature from 20 to 140°K was attributed to the annihilation of interstitials at vacancy defects because of interstitial mobility during irradiation. (auth) (UK)

52220 GROWTH OF URANIUM UNDER IRRADIATION AT 25°C. Weinberg, C.; Dural, J.; Conte, R. R. (CEN, Fontenay-aux-Roses, France). Phys. Lett., 27A: 690-1(Oct. 7, 1968). (In French).

Growth of α uranium has been measured as a function of burnup τ, for very low doses. The growth coefficient G is found to depend strongly on τ. The initial value is: G ≈ 45,000. (auth)

52221 MECHANICAL PROPERTIES OF ZIRCALOY-4 AFTER IRRADIATION AT 130, 650, AND 775°F. Harbinson, E. N.; Baroch, C. J. (Babcock and Wilcox Co., Lynchburg, Va.). J. Mater., 3: 107-15(Mar. 1968).

Six Zircaloy-4 capsules were irradiated in the Babcock & Wilcox Test Reactor (BAWTR), and the effect of numerous variables on the short-time mechanical properties of Zircaloy-4 tubing was determined in both the longitudinal and transverse directions. The mechanical properties included 0.2% offset yield strength, ultimate strength, fracture strength, and total and uniform elongations. Combined effects of hydrogen and irradiation at 130, 650, and 775°F on room-temperature tension tests of nonhydrided longitudinal and flattened ring specimens irradiated at doses up to 1.4 × 10^{20} nvt (>1 MeV) are reported. The room-temperature tensile and yield strengths increased with total neutron exposure for irradiation temperatures up to 650°F, the rate of increase being greater the lower the irradiation temperature. This increase in strength was accompanied by a decrease in the total and uniform elongation. The room-temperature yield and tensile strengths of the specimens irradiated at 775°F were slightly lower than before irradiation, but these changes in properties were not significantly different from those observed in specimens aged out-of-pile for like periods of time. Room-temperature uniform elongation values for both annealed and cold-worked material were ~2% after neutron irradiation at 130°F to an exposure of 4.5 × 10^{19} nvt (E > 1 MeV). A difference in irradiation behavior was noted for the longitudinal and transverse specimens, particularly after irradiation at 775°F. At this temperature the tensile strength in the transverse direction continued to increase, whereas in the longitudinal specimens the strength decreased. (BBB)

52222 RESISTANCE MEASUREMENTS ON α- AND β-IRRADIATED ALUMINUM SAMPLES UNDER DIFFERENT DEGREES OF DEFORMATION AT VARIABLE TEMPERATURES. Hartmann, Walter. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 176: No. 3, 121-37(1967). (In German).

The effect of α and β bombardment on strongly cold-rolled commercial aluminum was determined at 78, 196, and 273°K by measurements of the electrical resistance. The irradiation of strongly deformed aluminum samples with α particles at an irradiation temperature of 78°K showed that soft annealed foils showed the greatest resistance increase. With increasing degree of rolling the resistance increase decreases. At 196°K hard foils show a somewhat greater increase than soft foils. At 282°K no resistance change can be detected in undeformed material and hard samples show after 1200 min of irradiation an increase of 0.9%. In irradiations with 2 MeV soft samples show at 78°K a resistance increase beginning with the start of the irradiation and this increase reaches a saturation value. Strongly deformed foils show an initial decrease of the resistance, which passes through a minimum, sharply increases and ends in a saturation value. At 273°K a resistance increase occurs in soft-annealed samples after a given flux-dependent time. Hard sample materials shows first a slight increase, then a strong flux-dependent decrease, after passage through a minimum a flux-dependent saturation value is attained. A model interpretation of the measurements was given by the interaction of radio-induced point defects with dislocations caused by cold processing in the crystal. (tr-auth)

52223 ELECTRON DISPLACEMENT DAMAGE IN COPPER AND ALUMINIUM IN A HIGH VOLTAGE ELECTRON MICROSCOPE. Makin, M. J. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 18: 637-53(Sept. 1968).

Defect clusters were observed to form in copper and aluminum during examination at ~20°C in a high voltage electron microscope when the voltage was greater than ~500 kV and the beam current was high (0.1-0.4 μamps in a 5 μ spot). Experimental and theoretical considerations show that the damage was the result of the direct displacement of lattice atoms by the electron beam, resulting in the homogeneous nucleation of point defect clusters. In annealed copper the threshold electron energy required to produce the effect is orientation dependent, and the effective displacement energy E'_d is >~30 eV in the ⟨100⟩ and ⟨110⟩ directions, and <26 eV in directions away from the corners of the unit triangle. Complex effects are observed in copper previously neutron irradiated and partially annealed, quenched, or cold worked. The results are interpreted in terms of the nucleation of interstitial loops and the formation of submicroscopic vacancy clusters. (auth) (UK)

52224 IRRADIATION EFFECTS ON CORROSION AND ELECTROCHEMICAL BEHAVIOR OF STRUCTURAL MATERIALS. Gromova, A. I.; Morozova, I. K.; Gerasimov, V. V. At. Energ. (USSR), 25: 302-5(Apr. 1968). (In Russian).

Thermal neutron effects on corrosion and electrochemical behavior of pearlite steel and titanium zirconium alloys have been investigated. The short in-pile radiation (thermal neutron flux 10^{11}—10^{12} n/cm² · sec) has been found to markedly increase pearlite steel corrosion rate. The processes occurring at thermal neutron irradiation of zirconium alloys in-pile are entirely reversible. These processes are not reversible during the tests of titanium alloys and pearlite steel. The increase in the anodic process rate of zirconium and titanium alloys is probably due to a photoelectrochemical effect. The titanium absorbed energy threshold when a noticeable photoelectrochemical effect appears has been determined. A listing of 14 references and 4 figures are included. (tr-auth)

52225 EFFECTIVE NEUTRON DOSE DETERMINATION FOR FERRITE STEEL EMBRITTLEMENT. Adamovich, V. K. At. Energ. (USSR), 25: 58-9(July 1968). (In Russian).

Various methods and concepts used for evaluating neutron spectra effects on radiative damage of ferrite steels were evaluated

using nuclear reactor vessel material with known mechanical properties and data on the neutron effects suitable for the comparisons. The results show that neutrons with less than 1 MeV energy contribute a considerable portion of the radiation damage while neutrons with energy higher than 1 MeV, with higher neutron spectra softness, contribute less to the radiation damage of ferrite steels and comprise only ~25% of the calculated fission spectra. Data obtained confirmed that the use of fast neutron flux with energy exceeding 1 MeV would result in considerably lower effects of neutron irradiation on reactor construction materials. (R.V.J.)

52226 CREEP OF HOLLOW CONCENTRIC TUBES. Blackburn, W. S. (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). J. Strain Anal., 3: 163-9(July 1968).

A long thick concentric circular tube surrounded by a thin concentric tubular fuel can was investigated while the inner tube was swelling at a constant rate. This swelling resulted from the accumulation of solid fission products. The inner and outer curved surfaces were treated as free, the interface as frictionless, and the axial strains as identical, and 2 alternative end conditions were treated, zero axial load and zero axial strain. Elastic effects were neglected. Circumstances under which the outer tube deformed at an appreciably smaller rate than the linear swelling rate of the inner were determined. It was found that there are 6 possible cases, when the outer tube is creeping or plastic and when the inner tube is creeping or plastic or partially both. For each of the conditions of each of the materials the ratio of the strain rate of the can to the swelling rate of the fuel was a function of a dimensionless parameter relating the relative strengths of the materials. Equations yielding the ratios of the axial and circumferential creep rates of the outer tube to the swelling rate of the inner were determined in terms of the material parameters for each of the above conditions and have been solved on the assumption that these ratios are small. From these results the times to attain a given ductility of the can were calculated for various geometries and material properties appropriate to a nuclear fuel element. (BBB)

52227 INFLUENCE OF RADIATION ON THE INCEPTION OF BOILING IN LIQUID SODIUM. Claxton, K. T. (Atomic Energy Research Establishment, Harwell, Eng.). pp IIb8,1-11 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

An analysis was carried out of the influence of nuclear radiation on the initiation of vapor bubbles in the bulk of liquid sodium. Several different types of radiation were considered, namely, electrons, protons, alpha-particles, photons, neutrons, fission fragments and alpha-recoils. The energy loss per unit path length in liquid sodium have been calculated for those different forms of radiation as a function of their energy using various theories. A comparison of these results with the energy requirement for formation of an equilibrium vapor bubble derived from classical nucleation theory has been effected by use of a characteristic path length related to the bubble radius. The analysis suggests that the only likely form of interactions capable of initiating nucleation are "knocked-on" sodium atoms produced by fast neutrons. This, moreover, seems probable only at saturation pressures of 10 atmospheres and above. (auth)

Ceramics and Cermets

Refer also to abstracts 51176, 52126, and 52128.

52228 THE ROLE OF NUCLEAR RESEARCH IN S.A. Roux, A. J. A. S. Afr. Mining Eng. J., 78: 1875; 1889(Aug. 11, 1967).

South African nuclear research is heavily concerned with investigations into the fuel aspect of reactors; South Africa has a material interest in the processing of U into suitable fuel forms. The economic production of nuclear energy by obtaining long burn-up time of the fuel is being examined. It will probably be necessary to increase the working temperature to obtain higher efficiency in the process of converting heat energy to electricity. Under the nuclear radiation, structural and moderator materials can experience damage which can modify their macroscopic physical properties of hardness, elasticity and elastic limit, tensile strength, and dimensions. The influence of thermal agitation on lattice defects deserves attention because of its annealing effect. A future trend will probably be to irradiate materials at liquid N_2 temperature in a very high flux to freeze in the lattice defects. Studies are needed on the fundamental behavior of fuel material under irradiation using small samples; and technological studies on the fuel element, either in sections or of diminished dimensions, followed by investigating various aspects of the behavior of a fullsize fuel element. Studies of the evolution of nuclear characteristics of the fuel as a function of the amount of irradiation should continue. From the thermodynamic point of view, the most important problem at present is the use of an organic liquid as coolant but in South Africa there is, at present, very little active interest in this problem. It is necessary to know which reactions in coolants are caused by radiation so that corrosion can be minimized. Consequently, it is necessary to be able to do irradiation testing at flux values equivalent to those obtained in power reactors. It is desirable to have irradiation facilities yielding neutron fluxes $>10^{13}$ n.cm^{-2} sec^{-2} fluxes ranging from 5×10^7 to 10^9 R/hr. (BBB)

52229 SIMULTANEOUS VAPOUR DEPOSITION OF URANIUM AND CARBON. Marinkovic, Slobodan; Suznjevic, Cedomir; Dezarov, Ivan. Bull. Boris Kidric Inst. Nucl. Sci., Chem., 19: No. 1, 1-3(Jan. 1968).

Recent data on the simultaneous pyrolytic deposition of U and C from gas mixtures of UF_6 and CH_4 at temperatures ranging from 1400 to 1600°C at gas pressures from 50 to 150 mm Hg are reported. Highest concentrations of U were found in samples deposited at about 1500°C. No definite relationship between the amount of incorporated U and total gas pressure was observed. Results of oxidation kinetics measurement are tabulated. (P.G.C.)

Corrosion and Erosion

Refer also to abstract 52277.

52230 PLASMA ARC TESTING OF HYPERVELOCITY MATERIALS. Goldstein, Ernst M. (Martin-Marietta Corp., Denver). J. Spacecraft Rockets, 5: 1232-3(Oct, 1968).

Forty-kW plasma arc tests with simulated air were conducted on two graphites (AGKSP and GP-48) and three graphite composites (with ZrC, ZrB_2, or HfB_2) at heat fluxes of 500- and 700-Btu/ft^2-sec for 30 seconds. Recession and weight losses were measured, and the results show that the composites are more resistant to ablation than the graphites. However, it is pointed out that this relative performance may very well be reversed at higher heat fluxes and temperatures, and some possible reasons are discussed. (D.L.C.)

52231 STUDIES OF SiC REACTIONS WITH HIGH-MELTING METALS AND OXIDES. Burykina, A. L.; Strashinskaya, L. V.; Evtushok, T. M. (Inst. of Problems in Material Studies, Kiev). Fiz.-Khim. Mekh. Mater., 4: 301-5(1968). (In Russian).

Data are obtained on SiC reactions with high-melting metals (Nb, Ta, Mo, and W) and oxides (BeO, MgO, ZrO, and ThO_2) in a vacuum at temperature from 1200 to 2000°C and 2 hr time-contact duration. (tr-auth)

52232 RATE OF OXIDATION OF GRAPHITE IN CARBON DIOXIDE. Turkdogan, E. T.; Koump, V.; Vinters, J. V.; Perzak, T. F. (United States Steel Corp. Research Center, Monroeville, Pa.). Carbon, 6: 467-84(Aug. 1968).

Experimental data are presented on the rate of oxidation of electrode graphite spheres (1/8 in. to 3/8 in. dia), blocks, and sized granules (8 to 30 mesh) in carbon dioxide–argon mixtures at one atmosphere total pressure, and in carbon dioxide at pressures up to 40 atm. The effects of size, pressure, and temperature on the extent of internal burning are demonstrated. It was found that internal burning occurred throughout, and that the rate was controlled by the chemical reaction of gas and carbon at one atm % CO_2 for spheres less than 0.2, 0.3, or 0.6 cm dia for 1100, 1000, and 900°C, respectively. For larger spheres, or at higher pressure or temperature, internal burning occurred only in a zone near the surface—that is, pore diffusion was incomplete. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 50950, 52277, and 53463.

52233 (DP-MS-68-24) PROPERTIES AND FABRICATION OF ^{170}Tm FUEL FORMS. Keski, J. R.; Smith, P. K. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). June 3, 1968. Contract AT(07-2)-1. 20p. (CONF-681002-2). Dep. CFSTI.

From Nuclear Metallurgical Symposium on Materials for Radioisotope Heat Sources, Gatlinburg, Tenn.

Natural thulium sesquioxide is a candidate target material to produce ^{170}Tm fuel forms for direct application in short-lived radioisotopic heat sources. Physical and chemical properties

of Tm_2O_3 are reviewed. Fabrication methods for oxide wafers of 97% of theoretical density and characteristics of wafers irradiated to an activity of about 2 W/g are described. (auth)

52234 (RT/ING–(68)3) EFFECT OF THE POROSITY OF SINTERED UO_2 AND THE KINETICS OF THICKENING OF GRAINS. Lepscky, C.; Marsico, B.; Pugnetti, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 44p. (In Italian). Dep.

Two series of samples of sintered UO_2, with density of 87 and 95% of the theoretical density (10.97 gr/cm³) were reheated under isothermal conditions to 2080°C in a high-frequency induction furnace. The reheating extended from 0.5 to 6 hrs. The ceramographic analysis led to the following conclusions. For high density UO_2 the grain growth mechanism conforms to the equations reported in the literature. The experimental parameters necessary for the quantitative application of the theoretical equations of grain growth to the case of the experimental irradiation of the same type of UO_2 were defined. A discontinuous mechanism of the grain growth in low density UO_2 was detected and a quantitative interpretation was attempted on the basis of the Zener relation. The formation of basaltic grains was noted in samples of low density UO_2 annealed for a long time. (tr-auth)

52235 HYDROTHERMAL CRYSTAL GROWTH OF Y_2O_3 AND ZnS. Yamaguchi, S.; Katsurai, T. (Inst. of Physical and Chemical Research, Tokyo. Pilot Lab. Hiratsuka, Kanagawa, Japan). Z. Anorg. Allg. Chem., 356: 327-8(1968). (In German).

Precipitated samples of yttrium hydroxide and zinc sulfide, respectively, were thermally treated in their mother liquors at about 190°C. Hydrothermal reactions as well as crystal growth occurred, leading to ~5 μ Y_2O_3 and ~10 μ ZnS crystallites. Whereas Y_2O_3 behaved on electron diffraction experiments as a dielectric, ZnS behaved as a semiconductor. (auth)

52236 INITIAL STAGE OF URANIUM DIOXIDE ELECTROCRYSTALLIZATION FROM CHLORIDE MELT. Baraboshkin, A. N.; Kaliev, K. A. At. Energ. (USSR), 25: 193-6(Sept. 1968). (In Russian).

Nucleation of UO_2 crystals on a Pt microcathode by electrolysis of the molten mixture $LiCl-KCl-UO_2Cl_2-UCl_4$ at the temperature of 400 to 600°C was studied. This process was shown to require additional potential. It was established that the number of crystals on the cathode increases, while the concentration of UO_2Cl_2 decreases and the temperature falls. Dependence of the number of crystals on current density is close to linear. The form of crystals and their aggregates is influenced by electrolysis conditions. Under low temperatures, concentration, and current density, drop-like crystals are formed; under high temperatures, concentrations, and current density, one can obtain cubid and pine-tree crystals with clear faces. (auth)

52237 HEATING ELEMENTS FOR HIGH TEMPERATURE 2,500°K FURNACES IN AN OXIDIZING ATMOSPHERE. Anthony, Anne-Marie; Faucher, Michele (CNRS, Meudon, France). Compt. Rend., Ser. C, 267: 444-7(Aug. 5, 1968). (In French).

A stable and homogeneous fuel was obtained by direct dissipation of electric energy of a refractory oxide. Zirconium oxide with 4% CaO was used to illustrate established theoretical concepts which are valid for all refractory oxides. The operation of the 4 kW furnace was stable for more than 500 hr at 2,270°K, and was capable of attaining 2,500°K. (J.G.B.)

52238 STUDIES ON THE KINETICS OF SINTERING OF URANIUM DIOXIDE. Moorthy, V. K.; Soni, N. C. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: No. 1, 53-8(Mar. 1968).

Sintering behavior and the kinetics of sintering of urania powders prepared from ammonium diuranate by calcination at 600, 900, and 1300°C were studied in the temperature range of 900 to 1400°C. The influence of pre-sintering (prior soaking for 20 hrs at a lower sintering temperature) on the densification behavior at higher temperature was studied. Attempts were made to relate the densities attained at various times by the empirical equation, $D = Kt^n$, where D is the density attained at time t, and K and n are constants. The activation energies calculated from the data varied over a wide range. Attempts were made to explain the attainment of limiting densities at any one sintering temperature, the variation of densities attained between green pellets and pre-sintered pellets heated directly to sintering temperature, and the influence of origin and calcination treatments on the sintering behavior of the samples on the assumption that densification during sintering is due to the rate of elimination of 'crystalline' flaws (imperfections) in the material. (auth)

52239 OXYGEN TRANSPORT DURING OXIDATION. Lightstone, John B.; Pemsler, J. Paul (Kennecott Copper Corp., Lexington, Mass.). pp 187 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.-296; CONF-671024.

In a study of oxygen transport during oxidation, a large volume fraction of potential short circuit paths for oxygen diffusion was shown to exist in the oxide formed on Zr by oxidation between 500 and 1000°C in oxygen. Results of an oxygen tracer experiment were in agreement. X-ray line broadening measurements were used to estimate grain size of the oxide. Movement of oxygen was also studied by sputtering the oxide in a beam of argon ions in a mass spectrometer. Observations of the ^{18}O profile were used to derive a line diffusion coefficient for oxygen. Nickel oxidation at 1000°C was studied. The shape of the diffusion profile agrees with a model of material transport in which there is a significant contribution from oxygen lattice diffusion. (F.S.)

52240 DEVELOPMENT OF HOT-PRESSING TECHNIQUE FOR COMPACTING HIGH TEMPERATURE NUCLEAR FUEL ELEMENTS OF THE UC-TYPE. Makovec, Marijan (Ruder Boskovic Inst., Zagreb). Tehnika (Belgrade), 23: 1214-18(1968). (In Serbo-Croatian).

The development of the hot-pressing technique is described. Although the method has wide applicability, special emphasis is given to the results of compacting high temperature uranium monocarbide nuclear fuel elements. A survey of other compacting methods that can be used for the same purpose is briefly described. Two different apparatus that were constructed are described in detail. The first is a hot-press operating in an inert gas atmosphere; the second is an improved version comprising a vacuum chamber enclosing the heater and the sample. The latter was found to be especially convenient, due to the outgassing effect and, therefore, pellets with a very low residual porosity can be obtained. The whole unit consists of a 25 KW variable transformer, graphite die which serves as a heater, a double-wall water cooled vacuum chamber and an Edwards 2 SC 50 two-stage rotary pump. The temperature is controlled by means of an optical pyrometer through the glass window on the vacuum chamber. Finally, the results of some typical runs are presented in order to illustrate the effects of the pressure, temperature and the duration of the process upon the density of the uranium monocarbide pellets. (auth)

52241 NUCLEAR FUEL OF URANIUM CARBIDE DISPERSED IN SILICON CARBIDE. Nishikawa, Kazuyuki; Manabe, Genroku (Furukawa Electric Co., Ltd., Japan). FAPIG (Tokyo), No. 47, 198-201(Nov. 1967). (In Japanese).

Basic studies on fabrication of nuclear fuels of dispersions of UC in SiC are described. Methods for production of UC particles, coating the particles with SiC, and fabrication of fuel rods are discussed. (NSA–Japan)

52242 LOW-TEMPERATURE SYNTHESIS OF THE COMPOUND $6ZrO_2.Nb_2O_5$. Trunov, V. K.; Vladimirova, Z. A.; Komissarova, L. N.; Pol'shchikova, Z. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 457-8(1968). (In Russian).

Samples of $6ZrO_2 \cdot Nb_2O_5$ were synthesized by coprecipitation of zirconium hydroxide and $Nb_2O_5 \cdot xH_2O$ from a solution containing zirconium and niobium in a ratio 3 : 1, with subsequent annealing at different temperatures. X-ray phase analysis showed that the crystalline samples contained exactly the same phase with lattice constants within the experimental error. All of the samples were annealed for 5 hours. Determination of the size of the crystals was done for the reflections (200), and (020), and (002) by the approximation method. The standard was a sample of $6ZrO_2 \cdot Nb_2O_5$ annealed at 1200°C and with a crystal size known to be greater than 2000 Å. It was found that the crystal size varies linearly as a function of the change in annealing temperature in the interval from 500 to 900°C. After heating above 900°C the size of the crystals of $6ZrO_2 \cdot Nb_2O_5$ increases sharply. It can be assumed that formation of the phase $6ZrO_2 \cdot Nb_2O_5$ takes place with the simultaneous crystallization of amorphous precipitates of zirconium and niobium hydroxides at a temperature around 500°C. It is possible that this compound is already formed by dehydration of the hydroxide at lower temperatures, and that at about 500°C crystallization of the amorphous phase $6ZrO_2 \cdot Nb_2O_5$ takes place. (ATD)

52243 CATHODE OF LANTHANUM HEXABORIDE FOR HIGH-ACCURACY MICROTRON. Kindysheva, V. S.; Anan'ev, V. D.; Matora, I. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Porosh. Met., Akad. Nauk Ukr. SSR, No. 8, 48-51(Aug. 1968). (In Russian).

Methods for fabricating compacts of LaB_6, production of thermocathodes from the compacts, methods for joining to high-accuracy microtrons, conditions of thermocathode operation, and the results of their application in microtrons for the cyclic acceleration of electrons are described. Physical characteristics of LaB_6 com-

pacts including relative porosity, structure, and microhardness are given. (P.G.C.)

52244 PREPARATION OF PLUTONIUM OXIDE SOL. (to United States Atomic Energy Commission). British Patent 1,129,497. Oct. 9, 1968. Priority date Sept. 10, 1965, United States.

A method is provided for preparing a stable plutonium oxide sol to be used in the preparation of plutonium oxide solid reactor fuels, plutonium oxide microspheres, and mixed oxide fuel microspheres. Hydrous plutonium oxide is precipitated from a nitric acid solution containing tetravalent plutonium. The precipitate is washed in an aqueous solution containing 1 to 4 moles nitric acid per mole plutonium. The dispersion is heated and agitated until the first sol is formed. The first sol is dried until the residual nitrate is within range of 0.4 to 0.1 mole per mole plutonium. The resulting solid is dispersed in water forming a second low-nitrate stable sol. (F.S.)

52245 PRODUCTION OF GRAPHITE. McHenry, Edgar Ronald; Stout, Clyde Fiske (to Union Carbide Corp.). British Patent 1,130,013. Oct. 9, 1968. Filed Feb. 18, 1966.

A process for producing structural graphite having relatively high and substantially isotropic thermal expansion properties is described. The method consists of providing a coking charge and maintaining the charge above its melting point. The charge is mixed with carbon black and coked at 450 to 650°C and calcined at 900 to 1500°C. The calcined coke is mixed with binder which is carbonized and graphitized at 2600 to 3000°C in an inert atmosphere. (F.S.)

52246 PRODUCTION OF GRAPHITE. Stout, Clyde Fiske; Tolley, George Clifford (to Union Carbide Corp.). British Patent 1,130,829. Oct. 16, 1968. Filed Feb. 18, 1966.

A process is described for producing structural graphite with relatively high and substantially isotropic thermal expansion which closely matches that of refractory metal carbides. A coking charge is maintained above the melting temperature, mixed with carbon black and coked at 450 to 650°C, calcined at 900 to 1500°C, mixed with a carbonizable aromatic binder and formed in the desired shape. The binder in the shape is carbonized at 750 to 1000°C. The body is then graphitized at 2600°C to 3000°C. (F.S.)

52247 CERAMIC PART FOR ELECTRODES AND METHOD OF FABRICATION. Foex, Marc (to Commissariat a l'Energie Atomique). British Patent 1,130,518. Oct. 16, 1968. Priority date May 25, 1965, France.

A method for preparing ceramic parts for electrodes including electrodes for magnetohydrodynamic generators is described. The ceramic part is formed by crushing fused or sintered blocks of rare earth chromite to a particle size of less than 100 μ, adding a binder and shaping under a pressure of at least 2 tons/cm^2 and sintering. Electrodes prepared in this manner are electrically conductive from ambient temperature up to their melting temperature. (F.S.)

52248 METHOD FOR PRODUCING SINTERED URANIUM NITRIDE. Kasamatsu, Toshio (to Sumitomo Electric Industries, Ltd.). Japanese Patent 1968-15079. June 25, 1968. Filed Oct. 26, 1964.

Sintered uranium nitride of high density, composed solely of UN, can be obtained by the method proposed. During the sintering of uranium-nitride (powder) moldings in a nitrogen atmosphere at temperatures above 1600°C, the atmosphere is replaced by an inert atmosphere or vacuum (containing no nitrogen gas) at temperatures of 1050 to 1500°C, when the temperature of moldings is raised or lowered. (NSA of Japan)

52249 HOT-PRESSED ALUMINA–NIOBIUM GRADED COMPOSITES. Stapelton, Robert E.; Towner, Raymond J. (Westinghouse Electric Corp., Lima, Ohio). Amer. Ceram. Soc. Bull., 47: 560-1(June 1968).

The feasibility of establishing impervious, strong bonds across relatively large interfacial areas between high purity alumina and Nb metal components by the uniaxial hot pressing of powder preforms was determined. Simultaneous densification and bonding of metal and ceramic powders was used without the addition of secondary phases to promote interface reactions, or metallized layers, fluxes, or brazing alloys at the ceramic–metal interface. Composites were produced in a graded concentric ring configuration 0.38 in. OD by 0.25 in. thick having 4 cylindrical interfaces parallel to the direction of hot pressing between 5 preformed components. Tool steel dies were used for cold pressing preforms of metal, cermet, and alumina powders. Both the cermet and metal powders were cold pressed to match the density and length of the alumina preform. The preformed components were assembled and then hot pressed uniaxially in a single acting graphite die. Maintenance of concentricity and achievement of high density and bonding between components appeared to be satisfactory. The alumina was translucent, with a density of ~99% of theoretical. No porosity was observed. Particles of Nb and Al_2O_3 were mechanically interlocked at the various interfaces. The modulus of rupture in 3-point loading at the cermet–alumina interface was determined on several specimens as 24,200 psi, 34,600 psi, and 72,900 psi. No He leak was detected on 5 out of 6 Nb–alumina composites. The composites remained He leak-tight after heating and cooling from 1100°C, indicating that the inner and outer metal components could be machined and used for vacuum-tight joining purposes. (BBB)

52250 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF REFRACTORY CONCRETE. Chwetzoff, Wladimir; Condat, Marius; Dubois, Frederic (to Commissariat a l'Energie Atomique). British Patent 1,129,652. Oct. 9, 1968. Priority date Nov. 13, 1964, France.

Improvements in the manufacture of refractory concrete which enhance the mechanical properties at temperatures reaching and exceeding 450°C are described. Calcium aluminate cement containing an x- or γ-radiation absorbent compound is mixed with aggregates and water and maintained between 40° and 80°C during setting which crystallizes the cement in the cubic rather than the hexagonal system. The radiation absorbent compound may be serpentine, rare earth oxides, and or boron compounds. The improved concrete is useful in radiation shielding and in the construction of fast neutron reactors. (F.S.)

52251 IMPROVEMENTS IN OR RELATING TO FUEL MATERIALS FOR NUCLEAR REACTORS. Hazelden, Denis William John; Wheeler, Michael John; Norreys, John Jephson (to General Electric Co., Ltd.). British Patent 1,130,972. Oct. 16, 1968. Filed May 2, 1966.

Fuel composition and a method of preparing the fuel material consisting wholly or mainly of uranium niobium monocarbide solid solution are described. The U may be partly or wholly replaced by Pu. The fuel is prepared by arc melting a mixture of C, Nb, and U and casting the melt to form a body of a desired shape and size. (F.S.)

52252 PROCESS FOR THE FABRICATION OF FUEL ELEMENTS FOR NUCLEAR REACTORS AND FUEL ELEMENTS THUS OBTAINED. Blum, Pierre; Bochirol, Louis; Moreau, Claude (to Commissariat a l'Energie Atomique). British Patent 1,130,111. Oct. 9, 1968. Priority date Jan. 21, 1965, France.

The fabrication of spherical shaped fuel elements used in pebble bed reactors is described. Fuel kernels are prepared by molding plastic paste consisting of refractory materials containing fuel materials and binders that are chemically compatible with the refractory materials. The paste is shaped and dried and impregnated with gaseous hydrocarbons at 800 to 1000°C. Coatings of graphite are prepared in the same manner as the paste except that fuel material is not used. The graphite coating is impregnated with gaseous hydrocarbons at 800 to 1000°C. Graphite coated kernels are inserted in recesses formed in graphite balls. The ratio of the crushing strength of the fuel kernels to the crushing strength of the balls being equal to at least 1.5 : 1. (F.S.)

52253 FABRICATION OF SPECIMENS FROM PURE DENSE OXIDIZED ZIRCONIA. Garrett, Harold J.; Ruh, Robert (Air Force Materials Lab., Wright-Patterson Air Force Base, Ohio). Amer. Ceramic Soc. Bull., 47: 578-9(June 1968).

Because of the importance of pure dense stoichiometric zirconia specimens for research, a technique was developed for their preparation with emphasis on the reoxidation of vacuum fired specimens. Conventional uniaxial pressing techniques of ZrO_2 materials were used with a pressure of 1500 psi. Next the specimens were hydrostatically pressed at 60,000 psi for 5 min and then sintered in a vacuum induction furnace at 2300°C for 3 hr at 10^{-4} torr. They were then buried in raw ZrO_2 powder contained in an alumina crucible and heated to 1000°C in air. Complete reoxidation occurred in 18 hr. The mechanism of oxidation was not studied in detail. Since O diffusion is observed to be more rapid in the denser areas, grain-to-grain diffusion is indicated. Oxidation is indicated to occur by O diffusion through the grains. Good grain structure was observed without the predominance of grain pullout generally encountered in metallographically polished specimens. (BBB)

52254 PREPARATION OF CeO_2 HOLLOW MICROSPHERES. Gilman, W. S. (Monsanto Research Corp., Miamisburg, Ohio). Amer. Ceram. Soc. Bull., 47: 737(Aug. 1968).

Hollow microspheres of CeO_2 were produced in an induction coupled plasma torch. Reagent grade CeS_2 was spheroidized by dropping dense, irregularly shaped particles through the hot zone of an argon plasma at a rate of 1 g/min. The CeS_2 product was collected in the absence of oxygen and shown to be stoichiometric CeS_2 by powder x-ray diffraction analysis. The CeS_2

microspheres were then dropped through either a 50% oxygen–50% argon or 100% oxygen plasma, at a rate of 0.5 g/min. The product consisted of ~10 wt % unreacted CeS_2, 80 wt % CeO_2 and 10 wt % hollow CeO_2 microspheres. The ballooned product was separated from the overall plasma product by collecting that part which floated on water. Hollow CeO_2 microspheres were identified by powder x-ray diffraction techniques primarily as single-phase, stoichiometric CeO_2 with some unidentifiable phase present which was neither Ce_2S_3 nor CeS. The computed interplanar spacings, estimated visual intensities, and lattice parameters for CeO_2 compared favorably with recent literature values. CeO_2 does not balloon in either nitrogen- or oxygen-enriched plasma. (BBB)

Properties Evaluations

Refer also to abstracts 51043, 51175, 51191, 51192, 52238, 52243, 53260, and 53454.

52255 (AEC-tr-6960) EXPERIMENTAL INVESTIGATION OF REACTIONS BETWEEN URANIUM DIOXIDE AND WATER UNDER NONISOTHERMAL, QUASI-ISOBARIC CONDITIONS. Heuzel, N.; Kleine-Tebbe, A. (Battelle Institut e.V., Frankfurt am Main (West Germany)). Translated from a German report. 44p. Dep. CFSTI.

In supplementation of an isothermal investigation of chemical reactions between nuclear fuels and air or water vapor, the chemical and physical behavior of the UO_2 toward liquid water is examined under nonisothermal, quasi-isobaric conditions. (auth)

52256 (AERE-Trans-1094) ISOTHERMAL YOUNG'S MODULUS OF UO_2 AND UO_2–Mo CERMETS. Claussen, N. Translated by B. R. Skelding (Atomic Energy Research Establishment, Harwell, Eng.), from Ber. Deut. Keram. Ges., 44: 267-70(1967). 12p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 32992.

52257 (ANL-7425, pp 94-129) MATERIALS CHEMISTRY AND THERMODYNAMICS. (Argonne National Lab., Ill.).

Research progress is reported on high-temperature materials, including Pu systems with U, O, and C and the U–O system. Chemical studies were made of irradiated ceramic fuels and electron probe analyses were carried out on irradiated oxide fuel pins. Carbides were synthesized by metal–methane reactions and by conversion from oxides. Calorimetric studies were made on enthalpies of formation of NbB_2, TaB_2, AlF_3, CF_4, HF, IF_5, and ZrI_4. The thermochemistry of uranium compounds, separation of volatile fluorides, plutonium thermochemistry, the thermochemistry of fluorides of selected rare earths, exploratory combustions, high-temperature enthalpy calorimetry, and molecular orbital calculations of the hexafluorides of S, Se, and Te are discussed. Fundamental studies of the chemistry of liquid metals and liquid sodium coolant chemistry are considered. (M.C.G.)

52258 (AWRE-O-71/68) SIZE ANALYSIS OF WHISKERS: A SURVEY OF POSSIBLE METHODS. Cooper, R. E. (Atomic Weapons Research Establishment, Aldermaston (England)). Sept. 1968. 19p. Dep. CFSTI. UK 4s. 0d.

The importance of the diameter and length of reinforcing fibers in a composite material are explained and possible methods for determining these properties are considered. These methods include sedimentation, quantitative microscopy, optical Fourier analysis and the Coulter counter. It is concluded that quantitative microscopy using the Quantimet image analyzing computer offers the greatest promise. (auth)

52259 (CEA-R-3536) CONTRIBUTION TO THE STUDY OF THE SYSTEM (U,Pu)C,N. Lorenzelli, Robert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1968. 84p. (In French). Dep.

The reactions of UC, PuC, (U,Pu)C, UC_2 and $U(C_{1-x}O_x)$ with nitrogen at room temperature to 400°C are described. The influence of the uptake of nitrogen by the powders on the nature of the final product has been investigated; it has been shown that the sintered carbides are hyperstoichiometric. The reactions of carbon with UN, PuN, and (U,Pu)N have also been studied. Under vacuum, carbon reacts on the nitrides at temperatures as low as 1100°C; nitrogen is replaced by carbon and the final product is a carbonitride. The reaction is: $MN + x\,C \rightarrow MN_{1-x}C_x + (x/2)\,N_2^{\uparrow}$. The reaction is limited and the carbonitrides have a fixed composition in presence of M_2C_3 or MC_2; hence it is impossible to produce pure MC using the reaction. The ternary diagrams U–C–N, Pu–C–N, and (U,Pu)C–N have been drawn. They show clearly that it is possible to obtain single phase carbonitrides in a wide domain of compositions. (tr-auth)

52260 (CONF-670927) AGARD STRUCTURES AND MATERIALS PANEL SPECIALIST MEETING ON BRITTLE MATERIALS, LONDON, SEPTEMBER 4-6, 1967. (Advisory Group for Aerospace Research and Development, Paris (France)). 41p. Dep.

A summary of important and relevant material covered in papers at the conference is presented. Information is included on test methods, fracture theory, statistical theory, methods of characterizing materials, criteria for design, and conclusions. (J.R.D.)

52261 (KFK-729) MECHANICAL PROPERTIES OF UO_2. Engelhardt, G.; Hoffmann, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Feb. 1968. 53p. (In German). (EUR-3729). Dep.

A review of data shows that studies on the most important elastic and plastic properties of UO_2 are available. The data however are not sufficient since, especially the dependence of the grain sizes on external and structure-determined parameters were treated only partially and in an unsystematic fashion. The evaluation of the results was often impaired because information on the research conditions and the probe state was lacking. Generally it can be established that the mechanical behavior of UO_2 is not an exceptional case under the oxide ceramic material. The scattering lattice-physical processes were noticeably affected by structure-determined parameters, such as grain size, porosity, and foreign ions. In the studies on the elastic behavior, this effect was registered generally only phenomenologically; a formulation for the atomistic comprehension of the dependencies found is completely lacking. This is not true for the plastic behavior. It is known that the dislocation structure determined the form alteration resistance and the formation and motion of the dislocations depends on the texture state. The creep studies are better interpreted when the absolute values for the creep rates and activation energies deviate sharply from each other. Further studies are needed on this point. The effect of irradiation on the various properties, which were studied only in some works on hardness, is an additional lack. (tr-auth)

52262 (MLM-1540) EFFECT OF EXPERIMENTAL VARIABLES ON CRUSH STRENGTH DETERMINATIONS. Smith, W. H. (Mound Lab., Miamisburg, Ohio). Sept. 16, 1968. Contract AT(33-1)-Gen-53. 21p. Dep. CFSTI.

Possible effects of variables on the determination of the crush strength of $^{238}PuO_2$ microspheres were evaluated. Test results indicated that crush strength increases with particle size. It was unaffected by age in a test of microspheres up to 17 months old. Changes made in the production process have not affected the crush strengths of microspheres. Crush strength apparatus with a photoelectric detection system and with a force-transducer detection system yielded data which agreed within experimental error. Crush strength can be used for production quality control if the particle size-crush strength relationship is known. (auth)

52263 THERMAL CONDUCTIVITY OF EUROPIUM OXIDE (EuO) ACROSS THE CURIE TEMPERATURE. Morris, Robert G.; Cason, John L. Jr. (South Dakota School of Mines and Tech., Rapid City). Helv. Phys. Acta, 41: 1045-51(Oct. 20, 1968).

Results of measurements of the thermal conductivity K of a hot-pressed sample of EuO are presented for the temperature range 50 to 300°K. A sharp minimum occurs in the thermal conductivity near the temperature of the paramagnetic-ferromagnetic transition, 69°K. Behavior of K at low temperatures and near the magnetic critical temperature is discussed for magnetic solids. (auth)

52264 LOW-TEMPERATURE SPECIFIC HEAT OF GRAPHITE. Estermann, I. (Technion, Haifa, Israel). Helv. Phys. Acta, 41: 793-5(Oct. 20, 1968).

Work done in the Manhattan Project on the specific heats at ~20°K of graphite before and after irradiation is recalled. The results agreed better with a T^2 dependence rather than the expected T^3 dependence, and the irradiation effect was very small. Work by others (Gurney, DeSorbo and Tyler, and Krumhansl and Brooks) confirms the T^2 dependence, but a T^3 law may be possible at temperatures below 15°K. (D.L.C.)

52265 MASS TRANSPORT IN OXIDES. Proceedings of a Symposium Held at Gaithersburg, Maryland, October 22–25, 1967. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968. 226p. GPO $3.00. (NBS-Spec. Publ.-296; CONF-671024).

Thirty papers are included. Invited papers reviewed mass transport in alkali and silver halides as background, and topics relating to oxides including point defects, (both experiment and theory), lattice dynamics and ionic interactions, atomistic mechanisms of diffusion and ionic conduction, chemical diffusion, defect complexes, assessments of the experimental situation for diffusion and ionic conduction, and the availability of good research materials. In contributed papers, attention was focused on color centers in alkaline earth oxides, cation diffusion in

MgO, transport of both cations and anions in transition metal oxides, and coulometric and emf techniques for obtaining transport data. A panel discussion summarized the work of the conference. Separate abstracts were prepared for nine of the papers. (D.L.C.)

For abstracts of individual papers see: 52239, 52266–52269, 52287–52289, and 52864.

52266 SELF-DIFFUSION OF OXYGEN IN NEODYMIUM AND SAMARIUM SESQUIOXIDE. Stone, G. D.; Weber, G. R.; Eyring, L. (Arizona State Univ., Tempe). pp 179-86 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

Oxygen self-diffusion coefficients were measured for Nd_2O_3 (A-type) and Sm_2O_3 (B-type) and an estimate was made for the diffusion coefficient of Er_2O_3 (C-type) at 1000°C using the method of isotope exchange. The rate of change of ^{18}O in the gas phase in equilibrium with a solid sample was measured by a mass spectrometer. The enriched oxygen gas was circulated over the sample and through a leak valve which continuously admitted a small amount of the gas directly into the analyzer of the mass spectrometer. Over the range of pressures used (30 to 300 mm Hg), there was no pressure dependence noticed. The self-diffusion coefficients as a function of temperature, determined in the range of 700 to 1000°C using an exact solution of Fick's second law with a first order exchange reaction at the surface, were: Sm_2O_3 (99.9%), $D = 9.2 \times 10^{-6} \exp(-23.5 \pm 2$ kcal/RT), Sm_2O_3 (99.998%), $D = 6.0 \times 10^{-6} \exp(-21.3 \pm 0.5$ kcal/RT), and Nd_2O_3 (99.999%), $D = 1.3 \times 10^{-4} \exp(-31 \pm 2$ kcal/RT). The value for the diffusion coefficient of Er_2O_3, estimated at 1000°C, was 10^{-14} cm^2/sec. The low value measured for the heat of activation and the lack of pressure dependence indicated that the diffusion was probably extrinsic. While the systematic errors were large, the measured values for the heats of activation indicated a possible correlation to structure and the lanthanide contraction. (auth)

52267 A CHEMLA EXPERIMENT IN BeO. Cline, C. F.; Newkirk, H. W.; Condit, R. H.; Hashimoto, Y. (Univ. of California, Livermore). pp 177-8 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

The drift of ^7Be tracer in BeO at 1550°C under the influence of an externally applied dc electric field was determined by a sectioning technique. Reasonable agreement was obtained with the Nernst–Einstein relation. (auth)

52268 MEASUREMENT OF HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF NON-STOICHIOMETRIC OXIDES USING SOLID STATE EMF AND COULOMETRIC TECHNIQUES. Steele, B. C. H. (Imperial Coll. of Science and Tech., London). pp 165-72 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

The relative partial molar free energy of oxygen in a number of non-stoichiometric oxides, TiO_2, VO_2, NbO_2, MoO_3, UO_2, has been measured as a function of composition and temperature (700 to 1100°C) using galvanic cells incorporating solid oxide electrolytes. The data have been analyzed to find the region of nonstoichiometry over which the dilute solution laws can be applied and the associated values for the partial heats of solution of oxygen are briefly reviewed. A coulometric technique was successfully employed to vary the oxygen content of certain of the oxides, and the advantages and present limitations to this method of controlling the composition of non-stoichiometric oxides are discussed with reference to the different cell assemblies and oxide systems examined. (auth)

52269 IONIC CONDUCTIVITY IN OXIDES: EXPERIMENTAL PROBLEMS; SURVEY OF EXISTING DATA. Heyne, L. (Philips' Research Labs., Eindhoven, Netherlands). pp 149-64 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

Electrically insulating oxides may show electronic as well as ionic conduction when heated to a high temperature. To characterize this high temperature conductivity, it is necessary to separate both contributions and to study their dependence on oxygen pressure and doping. The theory is discussed on which methods for determination of the conductivity components are based. Starting from general charge transport equations, it is possible to express electronic and ionic currents in terms of two gradients; that of the electrochemical potential of electrons, and that of the chemical potential of oxygen. The first is measured with metal contacts, the second determined by the local oxygen partial pressure. The basic assumption is made, that local thermodynamic equilibrium between all charge carriers and the lattice is undisturbed by current flow. In practice, different boundary conditions can be obtained by a choice of electrodes with special properties with respect to reversibility or blocking action. This opens the possibility of the determination of transport numbers. Four different situations are considered: both contacts reversible and in the same atmosphere; both contacts reversible but at different oxygen pressures; blocking of the ion current; blocking of the electron current. Special attention is paid to the question of how close the situation on which the quantitative evaluation of the experiment is based is approximated by the practical arrangement. Finally, a short review is given of the most important properties of those oxides, about which dependable quantitative information is available in literature. (auth)

52270 INTERACTION OF URANIUM DICARBIDE WITH LIQUID EASILY MELTABLE METALS. Funke, V. F.; Dvoryak, V. K.; Kharitonov, A. V. Izv. Akad. Nauk SSSR, Metal., No. 4, 233-7(July-Aug. 1968). (In Russian).

The solubility of C at 1100°C in liquid Al is determined as 0.009 at. %, in liquid Sn as 0.04 at. %, and in liquid Pb as 0.09 at. %. The solubility of UC_2 in Sn in the presence of C increases with increased temperature from 1000 to 1750°C from 0.05 to 0.35 at. %. With increase of the absolute size of the negative values of the free energy of formation of the carbides of the metal solvents in the series Pb, Sn, Al the equilibrium concentration of U increases and the equilibrium concentration of C decreases. In the system Sn–C–U–Me the equilibrium concentrations of U and fusible metals (Me) increase with decrease of the negative size of the free energy of formation of the carbides of the fusable elements. (tr-auth)

52271 RELATION OF THE PHYSICOMECHANICAL PROPERTIES OF THE CARBIDES OF THE METALS OF THE IV–VI GROUPS OF THE PERIODIC SYSTEM WITH THEIR ELECTRON STRUCTURE AND THERMODYNAMIC PARAMETERS. Tumanov, V. I.; Yudkovskii, S. I.; Chernyshev, V. V. Izv. Akad. Nauk SSSR, Metal., No. 4, 212-19(July-Aug. 1968). (In Russian).

The physico-mechanical properties of the carbides of Ti, V, Nb, Ta, Cr, Mo, and W with bound C contents approaching stoichiometry are investigated. The stability and deformation properties under uniaxial compression at room and elevated temperatures, the specific electric resistance and normal modulus of elasticity at room temperature, and the Vickers hardness at room and elevated temperatures are determined on compact samples. The relations of the acceptor capacities of the metal, the specific energy of atomization, and the free energy of formation of the carbides with the magnitude of the hardness, modulus of elasticity, and specific electric resistance are shown. On the basis of the analysis of the experimental data a generalized diagram showing the relation between the structure and properties at different temperature of the carbides of the metals of the IV–VI group is constructed. (tr-auth)

52272 EFFECT OF HIGH PRESSURE ON THE STRUCTURE AND HARDNESS OF SOME REFRACTORY CARBIDES. Koval'-skii, A. E.; Prikhna, A. I.; Rybakova, E. A.; Timofeeva, I. I.; Shul'zhenko, A. A. Izv. Akad. Nauk SSSR, Metal., No. 4, 231-2 (July-Aug. 1968). (In Russian).

As a result of the effect of high pressure (up to 100 kbar) and temperature (up to 1400°C) the increase of the microhardness of the carbides of Cr, Nb, Ta, and W is established within the limits 2600 to 3000 kg/mm^2 for all the carbides. The widening of the x-ray diffraction lines accompanies the increase of the microhardness, for which the concentration of the stress and breaking up of the region of coherent scattering can be responsible. (tr-auth)

52273 THERMAL CONDUCTIVITY OF POLYCRYSTALLINE GRAPHITE. Taylor, R.; Gilchrist, K. E.; Poston, L. J. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Carbon, 6: 537-44(Aug. 1968).

Measurements of thermal conductivity from 100 to 900°K and electrical resistivity at 80°K were made on two mutually perpendicular directions of two types of anisotropic polycrystalline graphites and of two isotropic graphites of different densities. The thermal conductivity curves can be fitted using expressions calculated for thermal resistance due to boundary and isotope scattering and a relation for Umklapp scattering derived from pyrolytic graphite. By invoking a factor to account for the reduction in conductivity due to porosity and irregular arrangement of crystallites in polycrystalline graphite, crystallite size values are obtained from thermal conductivity analysis. Crystallite sizes obtained from electrical resistivity measurements using the simple two band model are about ⅔ those derived from thermal con-

ductivity. Various reasons are suggested to explain the difference. (auth) (UK)

52274 RELAXATION OF TENSILE STRESS IN A REACTOR GRAPHITE AT 2000 TO 2700°C. Smith, M. C. (Los Alamos Scientific Lab., N. Mex.). Carbon, 6: 503-16(Aug. 1968).

Relaxation of tensile stress was studied in across-grain specimens of a commercial graphite at 2000 to 2700°C and initial stresses of 1000 to 3000 psi. Except at very short and relatively long times, stress decreased linearly with the logarithm of relaxation time. Persistent stress of about 1100 to 1200 psi remained at 2000°C when relaxation apparently had ceased. This decreased with increasing temperature to about 700 to 800 psi at and above 2400°C. Discontinuous changes in apparent activation energy and activation volume occurred near 2400°C, suggesting a change in relaxation mechanism at about that temperature. (auth) (UK)

52275 THE ULTRA-REFRACTORY CERAMICS: CARBIDES, NITRIDES, AND BORIDES. Whittemore, O. J. Jr. (Univ. of Washington, Seattle). Trend Eng. Univ. Wash., 20: 28-31(Apr. 1968).

The superior refractory and mechanical properties of a group of ceramics (carbides, nitrides, and borides) are described. Applications of these materials are listed and associated with their properties, including those of TiC, ZrC, HfC, VC, NbC, TaC, WC, and UC. Some of the carbides have the highest-known melting temperatures of materials. Hafnium carbide has the highest mp of any unmixed material, 7100°F. Boron carbide is the hardest and most abrasion-resistant material available in massive form. Since boron has a high neutron-capture cross section, boron carbide has been used for control and shielding in nuclear reactors. Boron carbide with boron in solution up to a content of 78% total boron has the anomalous property of a higher boron density than elemental boron itself. It is also more economical to produce than boron. Beryllium carbide is of interest as a neutron moderator for reactors, but is less stable chemically than the other carbides: it is slowly attacked in moist air at room temperature. (BBB)

52276 INSTALLATION FOR DETERMINING THE TEMPERATURE DEPENDENCE OF RESISTIVITY OVER THE RANGE OF TEMPERATURES 300 TO 2500° K. L'vov, S. N.; Mal'ko, P. I.; Nemchenko, V. F. Porosh. Met., Akad. Nauk Ukr. SSR, No. 8, 100-2(Aug. 1968). (In Russian).

An installation is described for precise measurements of temperature dependence of resistivity on short samples of cermet materials over the range of temperatures 300 to 2500°K. Measurements are conducted in vacuum or in inert medium. A three-phase tungsten tubular heater of a special design is used in the installation. A possibility is envisaged for measuring the temperature by the optical pyrometer and thermocouples. (auth)

52277 BERYLLIUM BASE CERMETS. II. CORROSION PROPERTIES AND POSSIBILITIES FOR INCREASING RESISTANCE IN MOIST GAS MEDIA. Ivanov, V. E.; Zelenskii, V. F.; Khorenko, V. K.; Matvienko, B. V.; Kornienko, L. A. Porosh. Met., Akad. Nauk Ukr. SSR, No. 8, 73-7(Aug. 1968). (In Russian).

In moist carbon dioxide gas at a temperature of 700°C cermet beryllium produced from beryllium powders previously oxidized has a high corrosion resistance considerably surpassing that of ordinary beryllium. In wet carbon dioxide gas (with 12% by volume H_2O) the alloys of beryllium with calcium, intermetallic $CaBe_{13}$ and beryllium produced from ultra-fine powder proved to be the most resistant to corrosion. (auth)

52278 STRUCTURE AND PHASE COMPOSITION OF SILICIDE COATINGS ON NIOBIUM. Zemskov, G. V.; Kogan, R. L.; Luk'yanov, V. M.; Viderman, V. S. (Odessa Polytechnical Inst.). Fiz. Metal. Metalloved., 25: 762-4(1968). (In Russian).

Two- and three-component diffusion coatings, obtained by diffusion bonding of chromium, titanium, and silicon to niobium, were studied. Three types of coatings were analyzed: silicon on chromium, silicon on titanium, and silicon on chromium and titanium. The purpose of the work was to analyze the cause of the improved oxidation and thermal fatigue resistance which result from the above coatings and to compare their heat resistance at 1250°C. The diffusion bonds were made by placing niobium in a container filled with a mixture of the powders and heating at 1150 to 1200°C for 15 hr. X-ray analysis was performed to determine phase composition. Results are given for one-component layers of chromium, titanium, and silicon on niobium. The chromium diffusion layer was composed of an outer chromium base solid solution with a $NbCr_2$ phase at the interface. The titanium layer was composed of a titanium base solid solution adjacent to a niobium base solid solution. Siliciding resulted in the formation of $NbSi_2$ throughout the coating. A micrograph of the cross section of a chromium-titanium coating on niobium is shown. X-ray analysis of its surface indicated that the chromium base solid solution had the parameter a = 2.94 Å. Within the layer, a solution of $TiCr_2$ and $NbCr_2$ formed, resulting in a rise of microhardness to 14,000 Martins/m^2 (Mn/m^2). In comparison, the microhardness of the one component layer of chromium was 2500 Mn/m^2 and that of $NbSi_2$ 11,000 Mn/m^2. The microhardness distribution of the two- and three-component coatings on niobium is shown. The two-component coating systems (1 and 2) had a constant value of microhardness of 11,000 Mn/m^2 to a depth of 45 microns where it dropped to a constant level of about 1950 Mn/m^2. The three-component system had three plateaus: one at 11,000 Mn/m^2 to a depth of 25 microns, the second at 14,000 Mn/m^2 from 25 to 50 microns, and the third at 1950 microns for the base material. Lattice parameters of the various phases in the coatings are given. Testing for heat resistance was done at 1250°C for 50 hr. Oxidation of the three-component coating system proceeded at a rate that was 40 to 50 times slower than that of the two-component coating systems. (ATD)

52279 EFFECTS OF PROLONGED ISOTHERMAL TREATMENT ON THE PROPERTIES OF ZrO_2 REFRACTORY MATERIAL. Karaulov, A. G.; Grebenyuk, A. A.; Gul'ko, N. V.; Rudyak, I. N.; Zoz, E. I. Ogneupory, No. 9, 45-51(Sept. 1968). (In Russian).

Changes in physico-chemical properties of ZrO_2 refractory materials exposed to 50 to 240 hr isothermal treatment at 1200, 1400, 1600, and 1700°C were investigated. The maximum destabilization of the ZrO_2 resulting in porosity up to 2 to 2.5% was observed at 1400°C in specimens of ZrO_2 stabilized with CaO. At maximum destabilization temperature, the strength and ductility modulus are increased due to the formation of monoclinic phase shells around ZrO_2 cubic grains and reduced grains which create an elastic stress in the material. (R.V.J.)

52280 PHYSICOCHEMICAL PROPERTIES OF HEAVY-METAL FLUORIDE SYSTEMS. II. LIQUID SOLID PHASE EQUILIBRIUM OF URANIUM HEXAFLUORIDE–TUNGSTEN HEXAFLUORIDE SYSTEM. Prusakov, V. N.; Ezhov, V. K. At. Energ. (USSR), 25: 64-5(July 1968). (In Russian).

The turbidity and differential thermographic methods were used for determining the liquid-solid phase equilibrium of uranium hexafluoride-tungsten hexafluoride system. Data obtained showed that the uranium hexafluoride-tungsten hexafluoride system does not exhibit any tendency to form a solid solution and is related to eutectic type mixtures. The uranium hexafluoride-tungsten hexafluoride system shows a positive deviation from the Schrödinger equation. (R.V.J.)

52281 PROPERTIES OF NIOBIUM AND TITANIUM CARBIDE ALLOYS IN THE DOMAIN OF THEIR HOMOGENEITY. Samsonov, G. V.; Upadkhaya, G. Sh. Porosh. Met., Akad. Nauk Ukr. SSR, 69: No. 9, 70-4(Sept. 1968). (In Russian).

The electric resistance and microhardness of crystalline NbC–TiC solid solution are studied in the homogeneity domain. (auth)

52282 THERMAL CONDUCTIVITY OF BRAZED EXPANDED PYROLYTIC GRAPHITE TO 700°C. Allen, Robert D. (McDonnell-Douglas Corp., Richland, Wash.). Amer. Ceram. Soc. Bull., 47: 717-21(Aug. 1968).

Expanded pyrolytic graphite with a sp gr of 0.64 was prepared from pyrolytic foil by coating layers with phenolic resin, stacking, ing, and heat-treating at 2000°C. Two brazes, each about 1/16 in. thick, were used to join graphite specimens perpendicular to the layer planes; the braze compositions consisted of Ag–Cu–Ti on 316 stainless steel and Ti–Zr–Be on Cb–1Zr. Thermal conductivity was measured with the heat flow parallel to the graphite layers and perpendicular to the braze layers. The experimental apparatus employed unidimensional heat flow between an electrical resistance heater and a water-cooled heat sink. Heat losses were minimized by use of evacuated lateral insulation having a thermal conductivity more than 3 orders of magnitude less than that of the graphite. Chromel-alumel thermocouples and a high purity aluminum specimen supplied thermal gradient and heat flow rate data. The parallel planar thermal conductivity of expanded pyrolytic graphite, with a sp gr of 0.64, varied from 0.29 cal/cm sec °C at 100°C to 0.17 cal/cm sec °C at 700°C. These values contrast with reported thermal conductivities of 1.0 to 0.4 cal/cm sec °C over this temperature range for full density pyrolytic graphite. Thermal conductivity was not appreciably altered by a single braze zone, perpendicular to the planes, consisting of (1) 5 to 6 mils of Ag–Cu–Ti alloy on 20-mil 318 stainless steel or (2) 5 to 6 mils of Be–Ti–Zr alloy on 30-mil columbium-1 zirconium. Thermal conductivity of brazed expanded pyrolytic graphite was not significantly altered by 1000 thermal cycles between 175° and 730°C. (BBB)

Structure and Phase Studies

Refer also to abstract 52242.

52283 (ANL-7449) 62E8207: A PROGRAM FOR THE STATISTICAL ANALYSIS OF DEFECTS IN NONSTOICHIOMETRIC METAL OXIDES. Strecok, A. J.; Atlas, L. M. (Argonne National Lab., Ill.). June 1968. Contract W-31-109-eng-38. 19p. Dep. CFSTI.

The defects in an equilibrium assembly in a nonstoichiometric metal oxide have a characteristic distribution over the possible range of spacings and energies. The distribution may be calculated by a statistical system that divides the spacing and energy ranges into discrete levels by means of the spacing parameter. A program is described and listed for the required computations and the estimation of thermodynamic quantities. (D.L.C.)

52284 (AI-AEC-12703) PHASE RELATIONSHIPS IN THE ($\alpha + \delta$) REGION OF THE Zr–H SYSTEM. Moore, K. E.; Nakata, M. M. (Atomics International, Canoga Park, Calif.). Sept. 30, 1968. Contract AT(04-3)-701. 47p. Dep. CFSTI.

The $(\alpha+\delta) \rightleftharpoons \delta$ phase boundary of the Zr–H system has been defined on the basis of studies performed on zirconium hydrides containing 4 at. % U (SNAP fuel). The methods used include optical hot stage microscopy and room-temperature metallography, dilatometry, and x-ray diffraction. This boundary was found to exist between about 1.33 H/Zr at 1020°F and 1.60 H/Zr at 75°F. A metastable phase, γ' coexisting with α and δ phases, was found to transform to δ at about 560°F between 1.20 H/Zr and the $(\alpha+\delta) \rightleftharpoons \delta$ boundary (1.50 H/Zr). (auth)

52285 (NAA-SR-12486) GRAPHITE CRYSTAL GROWTH. Austerman, S. B.; Wagner, J. W.; Myron, S. M. (Atomics International, Canoga Park, Calif.). Aug. 15, 1968. Contract AT(04-3)-701. 22p. Dep. CFSTI.

Graphite single crystals were grown by precipitation from carbon-saturated molten iron and nickel. They were grown with low nucleation and growth rates, under conditions of low supersaturation, using slow-cooling and steady-state thermal gradient methods. Crystals produced included thin platelets, up to 3 cm across and a fraction of a mm thick; tabular crystals, measuring several mm across; and a form not previously reported—columnar crystals, up to 2 mm long. Details of crystal characterization, including crystal morphology, cleavage, twinning, etching, dislocation geometry, and lattice distortions, were examined. The crystals most nearly approaching ideality were the columnar crystals. Those with the greatest amount of mosaic substructure were the thin platelets. The characterization details are correlated with growth conditions. From this work, it is concluded that, with sufficient attention to details and abundant patience, growth of high-quality graphite crystals with substantial size has been demonstrated to be feasible. (auth)

52286 ON THE MECHANISM OF PHASE TRANSITIONS OF UO_{2+25}. Goto, K. (Showa Denko K. K., Tokyo). Solid State Commun., 6: 653-5(Sept. 1968).

The phase transition of U_4O_9 observed in specific heat measurements, and the difference between UO_{2+x} and two U_4O_9 phases, are discussed. U(IV) ions and U(V) ions are ordered in U_4O_9 and disordered in UO_{2+x}. The transition of U_4O_9 at 330°K is a "perfectly ordered state–imperfectly ordered state" transition. (auth) (UK)

52287 THEORY OF THE ENERGETICS OF SIMPLE DEFECTS IN OXIDES. Boswarva, I. M. (Queens Coll., Flushing, N. Y.); Franklin, A. D. pp 25-32 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

Currently, defect formation energy calculations for ionic crystals rest upon the applicability of two-body short-range interactions; additivity rules that allow assignment of ionic parameters, such as radius, charge, polarizability; independent of ionic displacement; and a functional form to express the dependence of the short-range interaction potentials on the distance between the two ions. An examination of the properties of the alkaline-earth chalcogenides shows that additivity rules for ionic radii and polarizabilities apply as well to them as to the alkali halides. Further, shell-model fits to both the static and dynamic properties of MgO, UO_2, and ThO_2 indicate that a model based upon two-body potentials can be used to describe these simple oxides. Attempts to calculate formation energies of vacancies in MgO have been unsuccessful. The problem may lie with the functional dependence for the oxygen-oxygen interactions, which are attractive in the shell model fits and are not likely to be well described by the exponential dependence upon ion separation used in the defect calculations. (auth)

52288 DIFFUSION IN OXIDES: ASSESSMENT OF EXISTING DATA AND EXPERIMENTAL PROBLEMS. Birchenall, C. E. (Univ. of Delaware, Newark. Univ. of California, Livermore). pp 119-27 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

Ideal conditions for the direct measurement of diffusion coefficients in oxides are described. The need for careful measurement, whether the object is to measure intrinsic properties of pure oxides or the engineering properties of commercial materials, is emphasized. Oxides are classified as impurity-tolerant, impurity-sensitive or borderline to judge the likelihood that intrinsic properties have been measured. A survey of several oxide structure types is given to illustrate the state of the empirical literature. (auth)

52289 PURITY AND PERFECTION OF RESEARCH SPECIMENS OF OXIDES. Cleland, J. W. (Oak Ridge National Lab., Tenn.). pp 195-203 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.–296; CONF-671024.

Specific examples of the effects of pre-purification, crystal growth, characterization, and research involving oxides in the Research Materials Program of the ORNL Solid State Division were selected to indicate the current status of the purity and perfection of these particular materials, and to examine the primary experimental problems that stand in the way of better research materials. The coded and filmed collection of data sheets, abstracts, reports, open literature publications, and bibliographies of the Research Materials Information Center, various publications of the Electronic Properties and Defense Ceramics Information Centers, and the contents of a number of journals and books gave information on the initial purification, crystal growth, and final characterization of general classes of oxides, as well as a number of specific materials of interest. A number of individual research groups were contacted to obtain current information on the purity and perfection of those oxides of particular interest to their own research program. (auth)

52290 EQUILIBRIUM SOLUBILITY AND DIFFUSIVITY OF HELIUM IN SINGLE-CRYSTAL URANIUM DIOXIDE. Sung, Pei. Seattle, Univ. of Washington, 1967. 37p.

Thesis.

Helium saturation solubility and diffusivity in UO_{2-015} was measured over the pressure-temperature range of 700 to 1300 psi at 1200 to 1500°C. The saturation solubility increased with increasing pressure and temperature according to the predicted relationship for stoichiometric UO_2 and agreed in magnitude to within a factor of two. In the equation

$$\ln \frac{\frac{N_i}{N}}{1-\frac{N_i}{N}} = -\ln \frac{(2\,m)^{3/2}\,k^{3/2}\,\Theta^3}{Ph^3\,T^{5/2}} - \frac{W}{kT} + 4$$

m is the mass of helium atom, Θ is Debye temperature of UO_2, P is pressure, T is temperature, W is the heat of solution, k is Boltzmann's constant, and h is Planck's constant. The observed heat of solution was approximately 30 kcal/mole as compared with a calculated He strain energy of 5 kcal/mole. The diffusivity could be described by the equation: $D = D_0 \exp(-Q/RT)$. The value of Q is 12.7 kcal/mole. This low activation energy was felt to reflect He diffusion which was unhampered by defect clustering. Increasing pressure increased the diffusivity by a greater factor. The experimental He concentration vs. time curves does follow the spherical particle diffusion equations under this investigation. (Disser. Abstr.)

52291 THEORY OF THE EFFECT OF CRYSTALLITE BOUNDARIES ON THE PRINCIPAL THERMAL CONDUCTIVITIES OF HIGHLY ORIENTED GRAPHITE: THE EFFECT OF THE ELASTIC CONSTANT ^{44}C. Kelly, B. T. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Carbon, 6: 485-96(Aug. 1968).

The theory of the principal conductivities of highly oriented graphite as limited by crystal boundaries is re-examined using the recently measured value of the elastic constant C_{44}. The principal conductivities are calculated by use of the relaxation time approximation and on the assumption of the presence of crystal boundaries parallel and perpendicular to the hexagonal axis defining scattering lengths L_a and L_c, respectively. The lattice dynamics are those given by the semi-continuum model of Komatsu. It is shown that the introduction of the experimental value of C_{44} in the lattice dynamics leads to a satisfactory explanation of the "anomalous" temperature dependence of the basal conductivity.

Parallel to the hexagonal axis it is shown that, as surmised previously, the out-of-plane acoustic mode contributes the major part of the conduction for reasonable ratios of L_a/L_c. Experimental data on very perfect pyrolytic graphite are compared with the theory and a new comparison made of crystallite dimensions L_a derived from electrical and thermal property measurements. (auth)

52292 RARE GAS DIFFUSION IN CESIUM IODIDE: USE OF FISSION RECOIL DOPING TECHNIQUES. Elleman, T. S.; Mears, L. D.; Christman, R. P. (North Carolina State Univ., Raleigh). Contract AT(40-1)-3508. J. Amer. Ceram. Soc., 51: 560-4(Oct. 21, 1968).

Diffusion of radioactive ^{133}Xe in single crystals of CsI was measured using a homogeneous doping method in which ^{133}Xe was introduced through the decay of homogeneously distributed ^{133}I, and a recoil doping technique in which ^{133}Xe was recoiled into the specimen from an external fissionable source. The results for both techniques were consistent with a classical diffusion model and with each other. The diffusion coefficient was given by: $D = D_0 e^{-Q/kT}$ where $D_0 = 0.57 \pm 2.30$ cm^2/sec, and $Q = 1.01 \pm 0.04$ eV. The results show that classical gas diffusion applies in simple systems under ideal conditions, in contrast to the complex behavior frequently observed in fission gas diffusion studies with nuclear reactor fuels. The results also show that the recoil doping method may be a valid technique for the study of rare gas diffusion in nonfissionable solids, and that diffusion does not appear to be enhanced along the fission fragment track. (auth)

52293 HIGH-PRESSURE INDUCED PHASE TRANSITION IN ZrO_2. Kulcinski, G. L. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Amer. Ceram. Soc., 51: 582-4(Oct. 21, 1968). (BNWL-SA-1619).

Tetragonal ZrO_2 can be formed directly from the monoclinic form at 25°C by applying pressures greater than 37 kbars. The transition is reversible, and the tetragonal phase cannot be retained in a metastable condition at ambient conditions. (auth)

52294 CUBIC FIELD IN THE SYSTEM CaO–ZrO_2. Garvie, Ronald C. (Bureau of Mines, College Park, Md.). J. Amer. Ceram. Soc., 51: 553-6(Oct. 21, 1968).

The range of existence of the cubic phase in the system CaO–ZrO_2 was determined at 1300 to 1700°C, using the lattice parameter method. This technique could not be used at higher temperatures because of anomalous changes in the lattice parameter. The possibility of the existence of a compound, $CaZr_4O_9$, occurring at 20 mole % CaO, was inferred from x-ray data. The (hypothesized) compound appeared to undergo a phase transformation at about 1650°C. The cubic field was widened when $CaCO_3$ was substituted for CaO as a reagent, probably because of the formation of an intermediate active oxide. This widening of the field may shed light on some of the discrepancies in the literature. (auth)

52295 STUDY OF UMo_2O_8–UW_2O_8 SYSTEM. Rozanova, O. N.; Kovba, L. M.; Trunov, V. K. Vestn. Mosk. Univ., Ser. II. Khim., No. 4, 100-1(July-Aug. 1968). (In Russian).

UMo_2O_8–UW_2O_8 system was investigated by x-ray diffraction analysis at 850 to 1000°C. The formation of solid solutions of uranium tungstate in α-UNo_2O_8 was established in the range of concentrations of UW_2O_8 up to 83 mol %. The change of lattice parameters from UMo_2O_8 to 83% UW_2O_8 was given. (auth)

52296 TRANSPORT REACTIONS AND CRYSTAL GROWTH OF TRANSITION METAL NIOBATES. Emmenegger, Franzpeter; Petermann, Anton (RCA Ltd., Zurich). J. Cryst. Growth, 2: 33-9(Feb. 1968).

The conditions for chemical transport of transition metal oxides and Nb_2O_5 were investigated with the aim of preparing single crystals of transition metal niobates by chemical transport reactions. The use of Cl_2 or HCl as a transport agent allowed the growth of prisms and plates, several millimeters in size, of the following compounds: $MgNb_2O_6$, $CaNb_2O_6$, $FeNb_2O_6$, $FeNbO_4$, $MnNb_2O_6$, $CoNb_2O_6$, and $NiNb_2O_6$. The $CrNbO_4$ and $ZnNb_2O_6$ crystals were <1 mm^3. Previously proposed structural relations between transition metal niobates were confirmed by x-ray investigation of the transported crystals which grew under equilibrium conditions. The investigation of the chemical transport of transition metal oxides led to the preparation of Cr(III) oxide crystals ($2 \times 2 \times 3$ mm^3) and Cd oxide crystals (1 mm^3). (BBB)

Radiation Effects

Refer also to abstracts 52234, 52261, and 52264.

52297 SEGREGATION OF FISSION PRODUCTS IN NATURAL UO_2 PELLETS IRRADIATED AT HIGH TEMPERATURE. Taketani, Kiyoaki; Ichikawa, Michio (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 10: 426-34(Aug. 1968). (In Japanese).

Segregation of the non-volatile fission products in natural UO_2 irradiated at high temperature pellets was studied by ordinal autoradiography, Au-foil absorber autoradiography, and microsampling methods. The γ-emitting nuclides in the pellets were separated by either ion exchange resin or solid state detector. The irradiation undertaken at GETR was completed in 1961, and it can thus be assumed that the fission products now surviving in the samples are mainly β-emitting nuclides. A new method of $\beta-\gamma$ autoradiography with Au-foil absorbers of varying thicknesses was employed to determine the distribution of the β-emitting nuclides in the sample. Two sets of UO_2 pellets irradiated under identical conditions except for burnup were examined. The pellets from both sets possessed a microstructure showing extensive columnar grain growth, but revealed fission product distributions quite different from each other when examined with the methods in question. This difference in fission product distribution can be attributed to melting of the UO_2 pellets in one of the sets during irradiation. This explanation has been substantiated by out-of-pile simulation experiments in which the sample is heated along the centerline. The UO_2 pellets were found sintered with 0.1 wt % of coprecipitated $^{144}CeO_2$. (auth)

52298 DIMENSIONAL AND PROPERTY CHANGES OF GRAPHITES IRRADIATED AT HIGH TEMPERATURES. Engle, G. B.; Koyama, K. (Gulf General Atomic Inc., San Diego, Calif.). Carbon, 6: 455-66(Aug. 1968).

The linear dimensional changes of anisotropic and near-isotropic graphites were measured after irradiation in the range 300 to 1500°C to 3.3×10^{21} n/cm^2 (E > 0.18 MeV). The presence of a nongraphitizing impregnant coke in an anisotropic needle-coke graphite increased its volume contraction, reduced the anisotropy of dimensional contraction, and retarded turnaround in the direction perpendicular to extrusion. No changes in the thermal expansivities were observed, but all graphites studied exhibited a single linear relationship between thermal expansivity and linear dimensional change at 320 to 615°C. A separate linear relationship was observed for anisotropic or near-isotropic graphites at 840 to 1500°C. There was a shift toward higher contraction for the near-isotropic graphites. Thermal conductivities, measured at room temperature, were lower than the preirradiation conductivities. Fractional reductions ranged from 85% after irradiation at 300°C to 35% after irradiation at 1250 to 1500°C. After irradiation at 1200°C conductivity changes were annealed out of anisotropic graphites at 1500°C, while 2600°C was necessary to remove the changes from a near-isotropic graphite. (auth) (UK)

52299 PROPERTIES AND HIGH-TEMPERATURE IRRADIATION BEHAVIOR OF GRAPHITES PREPARED WITH UNCALCINED COKE. Engle, G. B. (Gulf General Atomic Inc., San Diego, Calif.). Carbon, 6: 447-54(Aug. 1968).

Molded graphite compacts, prepared with uncalcined coke or uncalcined coke and pitch binder, were studied. Volume shrinkage of 30% were observed during carbonization and graphitization. The volume changes were accompanied by a decrease in electrical resistivity and an increase in the strength of the compacts that contained a pitch binder. The strength of compacts without binder was low. During baking the filler particles developed large basal-plane cracks. Relatively few cracks were formed in the grains of compacts that contained no binder. Increasing the pitch content reduced the total porosity of compacts heat treated to 2600°C, but increased the closed porosity, and reduced the anisotropy of the compacts. A decrease in the anisotropy of linear dimensional contractions was observed in the specimens heated to 2600°C and of highest pitch content after irradiation at 1450°C to 3.25×10^{21} n/cm^2 (E > 0.18 MeV). The large basal-plane cracks formed in the filler particles during baking were closed during irradiation. These changes in the microstructure were accompanied by changes in density and porosity. Thermal expansion coefficients increased for samples without pitch binder, but no changes were observed in those with pitch binder. (auth) (UK)

52300 DILATION OF NEUTRON IRRADIATED GRAPHITE EXPOSED TO LIQUID SODIUM. Brocklehurst, J. E. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Carbon, 6: 545-54(Aug. 1968).

The dilation of irradiated graphite when exposed to liquid Na 600°C is considerably greater than that of unirradiated graphite and depends on the irradiation history of the specimen. The dilation increases with the fast neutron dose and is greater at low irradiation temperatures. Dilations as high as 12% were observed and specimens with high neutron damage completely disintegrated on exposure to Na. It is concluded that the quantity of Na absorbed is greater in irradiated graphite, and the reaction is probably strongly dependent on the changes in the electronic properties of graphite

on irradiation. Restraint tests suggest that smaller quantities of Na are taken up when the specimen is under a compressive stress. (auth) (UK)

52301 OXYGEN ADSORPTION AND ITS REACTIVITIES ON THE SURFACE OF IRRADIATED NICKEL OXIDE. Yamashina, Toshiro; Nagamatsuya, Takaaki (Hokkaido Univ., Japan). Shokubai, 9: No. 2, 38-41(Aug. 1967). (In Japanese).

The oxygen adsorption and its reactivities on the surface of NiO were studied by means of changing the surface state by irradiation. (1) The rate of reduction is considerably smaller in irradiated NiO. This may be due to increased adsorptivity of (surface) oxygen, caused by the irradiation. (2) The change in electric conductivity with CO_2 adsorption is small in the irradiated NiO. The change becomes larger with the vacuum heating temperature, especially in the range of 200 to 300°C. This is caused possibly by the adsorption of CO_2 on the Ni surface as well as the CO_2 adsorption onto the excess oxygen. (3) In the change of electric conductivity with the removal of excess oxygen, a peculiar phenomenon — often seen in n-type semi-conductors — is observed at about 200°C in the irradiated NiO. (NSA of Japan)

Plastics and Other Materials

Refer also to abstracts 50996, 52128, and 52229.

52302 (BARC-331) STUDY OF WOOD PLASTIC COMBINATIONS. Rao, K. N.; Gopinathan, C.; Moorthy, P. N.; Rao, M. H.; Vijaykumar (Bhabha Atomic Research Centre, Bombay (India)). 1968. 37p. Dep.

The development of wood-polymer combinations is reviewed. Properties of the wood such as dimensional stability, weatherability, and insect resistance are improved by radioinduced polymerization. Procedures of using methyl methacrylate, styrene, and vinyl acetate monomers for impregnating various woods are summarized. Irradiation procedures, post-irradiation treatment, evaluation of mechanical and physical properties, and a listing of the results on various woods are described. (J.C.W.)

52303 (CONF-660553-10) THERMAL EXCHANGES: HEAT TRANSFER, BURNOUT, AND FOULING. Courtaud, M.; Ricque, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1965]. 37p. (In French). Dep.

From Panel on Use of Organic Liquids as Reactor Coolants and Moderators, Vienna, Austria.

Tests made at Grenoble within the ORGEL project had the purpose of giving to planners data on the different hydraulic and thermal limitations of the reactor. These tests made it possible to obtain a precise correlation for the heat transfer without boiling, to develop a calculation method for the prediction of the conditions of the beginning of the degassing, and to verify that the probability of burnout by flux peaking is small and that the functioning up to a wall temperature equal to the saturation temperature of the non-gassed product presents no risks. The tests have also shown that fouling can be avoided during irradiation by using standard commercial terphenyl if the circuit is operated in the absence of oxygen and chlorine particularly. (tr-auth)

52304 CHEMICAL SYSTEMS RADIATION HEATING BY GAMMA RAYS. Makhlis, F. A. At. Energ. (USSR), 25: 209-13(Sept. 1968). (In Russian).

Theoretical and experimental research of γ-radiation heating of a number of materials has been carried out. It has been found that temperature induced by a given radiation dose can be considerably varied dependent on dimensions and shape of object, dose rate, thermal and physical properties of material (heat conductivity, heat capacity, density, chemical composition), and conditions of the heat transfer on surface of the object. It has been established that temperature in the center of massive polymer blocks can be great. This circumstance must be taken into account at γ-irradiation of polymers. (auth)

52305 METHOD FOR PRODUCING HIGH BORON-CONTENT SHIELDING CONCRETE. Ito, Norio (to Onoda Cement Co., Ltd.). Japanese Patent 1968-11793, May 18, 1968. Filed June 16, 1962.

The shielding thickness can be reduced, in comparison with conventional similar boron-containing shields in the proposed design. It is especially suitable for use in ship-propulsion reactors. Boron frit is added as an aggregate in the concrete in boron amounts of over 34 kg (over 109 kg as B_2O_3) per m^3 of concrete. (NSA of Japan)

52306 THE EFFECT OF THE MOISTURE CONTENT OF WOOD ON THE ABSORPTION OF GAMMA RAYS. Jokel, Jozef (Statny Drevarsky Vyskumny Ustav, Bratislava). Drevarsky Vysk., 2: 61-72(1965). (In Czech).

The absorption of gamma rays by lime wood was shown to depend on its moisture content. The density of wood ranged from 0.480 g/cm^{-3} to 1.020 g/cm^{-3}. The experimental relation between the linear absorption coefficient and the density of moist wood was established along with the experimental relation between the linear absorption coefficient and the moisture content of lime wood for moisture content under and above fiber saturation point and difference of regression coefficient of oven dry and of moist wood. Regression coefficients of dry and moist wood having the same density are not significantly different. In determination of density of moist wood, the moisture content of wood can therefore be neglected. (tr-auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstracts 51230, 52527, 52528, 52552, 52623, 52631, 52632, 52662, 52663, 52907, and 53169.

52307 (AD-665431) COSMIC RAY EFFECTS FROM ASSAY OF HELIUM ISOTOPES. Annual Summary Report No. 2, March 1, 1963-February 29, 1964. (Oxford Univ. (England)). 1968. 5p. (AFCRL-64-602). CFSTI.

Investigation was continued regarding measurements of cross sections of proton-induced nuclear reactions, extending irradiations to Fe and Ni stacks and to Bi. A detailed study of the diffusion of the relevant rare gases in metal lattices is discussed. The electron bombardment degassing furnace and mass spectrometer are being improved to cope with the high-detection sensitivity required. (USGRDR)

52308 (AD-669347) OBSERVATION AND FORECASTING OF SOLAR PROTON EVENTS. Air Force Surveys in Geophysics No. 203. Castelli, John P. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Mar. 1968. 28p. (AFCRL-68-0104). CFSTI.

Solar-burst characteristics in the radio microwave region are used to differentiate between large flares that might produce events and those that might not. Proton events produce high-level absorption, disrupt polar communications, and can be dangerous to man and equipment in space. They may precede the auroral and magnetic storms that disturb many radiowave propagation systems. The probability of a proton event can now be predicted, an AFCRL study of the characteristics of flare-associated centimeter radio bursts having established that a signature of proton events is a high flux density in the 3-cm region and a particular burst peak flux spectral configuration. (auth) (USGRDR)

52309 (AD-669624) ATLAS OF LUNAR DATA. VOLUME III. PLOTS OF IONOSPHERIC FARADAY ROTATION AND ELECTRON CONTENT VERSUS TIME, 1964. Webb, Harold D. (Illinois Univ., Urbana. Electrical Engineering Research Lab.). 1968. Contract DA-28-043-AMC-01710(E). 353p. CFSTI.

Volume III of the Atlas of Lunar Data contains plots of the Faraday rotation angle, Omega, and plots of electron content, eta, both plotted versus CST and LTASP, for the data obtained from January 1, 1964 through December 31, 1964. Seasonal averages of eta plotted versus LTASP, are also included. The material is presented as discussed in the Description of the Atlas of Lunar Data given in Volume I. The plots for the period January 1 through June 30, 1964 are relative. The plots for the period July 1 through December 31, 1964 are based on absolute values of Omega and eta. (auth) (USGRDR)

52310 (AD-672330) THE SOLAR FLARES OF AUGUST 28 AND 30, 1966. Zirin, Harold; Lackner, Dora R. (California Inst. of Tech., Pasadena. Palomar Observatory, Pasadena, Calif. Carnegie Institution of Washington, D. C.). 1968. Contract N00014-67-C-0140. 34p. (TR-1). CFSTI.

Observations of the class 3+ flare of August 28, 1966, made at the Mount Wilson Observatory are described. This great proton flare followed the sequence. (1) precursor flare; (2) filament eruption; (3) beginning in penumbra of large spot; (4) rapid elongation in two strands; (5) great spray and surface wave; (6) rapid separation of two strands to maximum brightness; and (7) slow speed of brightness and decay. (USGRDR)

52311 (BNL-50114) THE RISE AND STABILITY OF THE EARTH'S ATMOSPHERE. Brookhaven Lecture Series Number 64. Berkner, Lloyd V. (Southwest Center for Advanced Studies, Dallas, Tex.); Marshall, Lauriston, C. (Southern Illinois Univ., Carbondale). Mar. 8, 1967; Revised June 1968. 10p. Dep. CFSTI.

The purpose of this lecture was to describe progress of the work that may lead to a general theory of planetary atmospheres of the terrestrial-type planets: Mars, Earth, Venus, and Mercury. The history and development of the terrestrial atmosphere are considered with special attention being given to the oxygen buildup. (W.D.M.)

52312 EFFECT OF PROGRESSIVE ALFVEN WAVES ON THE PROFILES OF SOLAR SPECTRAL LINES. Maltby, P. (Univ. of Oslo). Solar Phys., 5: 3-14(Sept. 1968).

Progressive Alfvén waves set the atoms in oscillatory motion. The radiation will be absorbed (emitted) at a Doppler-shifted wavelength; the Doppler shift is determined by the velocity given to the atoms by the wave. The effect of the waves on the line profile, integrated over one period, is given for a few simple cases. A brief discussion of the possible application to sunspots is presented. (auth)

52313 PRINCIPLES OF OPERATION OF SOLAR MAGNETOGRAPHS. Beckers, J. M. (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Solar Phys., 5: 15-28(Sept. 1968).

The principles of operation of photoelectric solar magnetographs are described in terms of the Poincaré sphere. The performance of photographic methods for measuring solar magnetic fields is compared with that of photoelectric magnetographs. (auth)

52314 RADIOASTRONOMICAL INVESTIGATIONS OF THE INHOMOGENEOUS STRUCTURE OF THE INTERPLANETARY PLASMA. Lotova, N. A. Usp. Fiz. Nauk, 95: 293-312(June 1968). (In Russian).

A review is given of the results of the investigation of the interplanetary plasma, characterizing its physical state and dynamics. The difference of principal radioastronomical methods makes it possible to separate the interplanetary medium into two regions: supercorona and interplanetary medium. Supercorona means the external regions of the solar corona, which gradually converts into the interplanetary medium. The parameters of the supercorona of the Sun, obtained from observations on the scatterings of radio waves from discrete sources of radiation in their period of approach to the Sun, are considered. The parameters of the interplanetary plasma, which can be obtained from the analysis of diffraction pictures, observed on the Earth from radiosources of small angular dimensions, are discussed. The connection between the parameters of the scattering of the radio waves on the earth and the parameters of the interplanetary plasma is considered. On the basis of data obtained from rockets and radioastronomical measurements an attempt is made to explain the nature of the nonhomogeneous structure of interplanetary plasma. It is shown that this leads to good agreement of the expected parameters of the nonhomogeneous structure with the radioastronomical data available. (tr-auth)

52315 POLARIZED LIGHT, MAGNETOGRAPHS, AND SOLAR MAGNETIC FIELDS. Hyder, Charles L. (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Solar Phys., 5: 29-41(Sept. 1968).

Analysis of the effects of polarization in lines used in longitudinal (Babcock) and transverse (Severni) magnetographs shows that previous straightforward analyses of observations may lead to spurious results. Measures of the longitudinal magnetic-field strengths in prominences and in the chromosphere have been underestimated by more than 10% whenever the measured field has been less than 10 gauss. Transverse magnetograph results are subject to resonance polarization effects that may dominate the magnetic signal. The panchromatic transverse magnetograph results discussed by Dollfus and Leroy are based solely on curve of growth polarization interpretations. Again, except within a few degrees of the center of the disk, resonance polarization effects can dominate, and radically change, the interpretations of the observations. (auth)

52316 SUNSPOT INTENSITIES AND THEIR CORRECTION FOR SCATTERED LIGHT. Kneer, F.; Mattig, W. (Fraunhofer-Institut, Freiburg i. B.). Solar Phys., 5: 42-9(Sept. 1968).

Photoelectric measurements of monochromatic spot intensities obtained with the domeless Coudé refractor in Anacapri are given. The scattered light superimposed on the spot, as deduced from measurements outside the Sun's limb, amounts on the average to about 4% of the photospheric intensity. The accuracy of the derived spot intensities is better than 10%. Two of four investigated spots yielded temperatures below 3900°K ($\Delta\Theta > 0.5$). (auth)

52317 THE O VI EMISSION FROM THE SUN. Kozlovsky, Ben-Zion (California Inst. of Tech., Pasadena); Zirin, Harold. Solar Phys., 5: 50-4(Sept. 1968).

The ionization equilibrium of oxygen is calculated for various temperatures. A peculiarity in the dielectronic recombination leads to a considerable fraction of O VI in the corona. Thus, the O VI lines may be emitted from the corona rather than the transition region. (auth)

52318 SURVEY OF CURRENT CORONAL VISIBLE LINE IDENTIFICATIONS. Wagner, William J. (Univ. of Colorado, Boulder); House, Lewis L. Solar Phys., 5: 55-60(Sept. 1968).

A literature search was made pertaining to the identifications of coronal visible lines. Of over one hundred lines reported seen at eclipses, about forty identifications are widely quoted. Close scrutiny of the literature, however, reveals that only twenty of

these identifications are not disputed by one or more authors. (auth)

52319 CONCENTRIC ELLIPSE MULTIPLE-ARCH SYSTEM IN THE SOLAR CORONA. Saito, Kuniji; Hyder, Charles L. (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Solar Phys., 5: 61-86(Sept. 1968).

A typical concentric ellipse multiple-arch system was observed in the solar corona during the February 4, 1962 eclipse in New Guinea. The following results have been obtained from analysis of a white-light photograph taken by N. Owaki. The arches are composed of four equidistant components, elliptical in shape, and almost concentric with a prominence at the common center of the ellipses. The prominence and arch system appear to be the lower region of a helmet-shaped streamer. The widths of the arches are observed to increase with height. Analysis was made in the light of three models for the coronal structures that could lead to the observed arches: (a) rod-like concentrations of electrons; (b) tunnel-shaped elliptical shells of electrons; and (c) dome-like ellipsoidal shells of electrons. Electron densities are derived for the models, and the dome-like model is excluded as a possibility for arch systems exhibiting a coronal cavity. The scale height in the arch-streamer region is found to be almost the same as that of the K corona, suggesting equal temperatures, density distributions, etc., in each region. There is a dark space (a coronal cavity) between the innermost arch and the prominence. The brightness of this cavity is $\frac{1}{5}$ that of the adjacent arch. It is 3% brighter than the background corona of the arch-streamer system. A comparison is made between the deficiency of electrons in the coronal cavity and the excess of electrons in the prominence. It is found that the ratio of the excess to the deficiency of electrons in the coronal cavity and the excess of electrons in the prominence. It is found that the ratio of the excess to the deficiency lies between 0.9 and 40. A comparison between the electron efflux from the "leaky magnetic bottle" possibly formed by red-shaped coronal arches and the electron influx into those arches from the chromosphere leads to the conclusion that the rod model is probably valid and that spicules appear to be an adequate supply for the electrons observed in the arches. The tunnel model may be valid, but in that case spicules are probably not the sources of the electrons observed in coronal arches. (auth)

52320 MAGNETIC-FIELD STRUCTURE ASSOCIATED WITH CORONAL STREAMERS. Sturrock, P. A. (Stanford Univ., Calif.); Smith, Sheldon M. Solar Phys., 5: 87-101(Sept. 1968).

An interesting coronal structure was observed during the solar eclipse of May 30, 1965. This comprised a series of bright arches centered approximately on a quiescent prominence. A bright ray originated near the top of one of the arches and pointed almost radially away from the photosphere. The ray could be followed for 1.5 solar radii and was deflected towards a direction parallel to the equatorial plane. By comparing the photographs with Fraunhofer maps and magnetograms, the following interpretation of the structure was obtained. The prominence lies above the neutral line of an extended bipolar magnetic region. The bright arches coincide with flux tubes arising from small photospheric regions of enhanced magnetic-field strength. The ray represents a projection view of a thin region of enhanced plasma density in the neighborhood of a current sheet that separates two flux tubes of opposite polarity. The ray is interpreted as a coronal streamer, and it is suggested that all streamers are related to current sheets. (auth)

52321 AN INDEX OF IMPULSIVENESS FOR 2800-MHz IMPULSIVE SOLAR NOISE BURSTS. Basu, D.; Covington, A. E. (National Research Council, Ottawa). Solar Phys., 5: 102-10 (Sept. 1968).

The initial growth of intensity, I, of the impulsive solar noise burst observed at 2800 MHz has been fitted with a parabolic curve of the form $I = ct^2$ and the quantity c taken as the index of impulsiveness. Two groups of bursts comprising 85% of all impulsive bursts observed in 1962–63 and 1966 were selected for study. A good fit has been obtained for bursts having peak flux density up to 20 flux units, while for more intense bursts, the average observed growth is more rapid than the parabolic rate. The distribution of the index in the range 0.1 to more than 100 shows two peaks, one for c values 1 to 10 and another apparent peak for those with c greater than 100. The index is independent of the peak intensity of the burst and its position on the solar disc, while there is a small trend, indicating that shorter bursts are more impulsive than longer duration events. The more easily derived linear rate of rise, b = peak flux/interval from start to peak is related to the parabolic impulsive index by $b = 1.86\ c^{0.57}$. The nonlinear rate of expansion of a flaring volume suggested by Pneuman when applied to explain the parabolic rise of microwave bursts indicates that the impulsiveness of bursts is inversely related to the contained magnetic field. (auth)

52322 A MODEL FOR TYPE-IV EMISSION IN THE SOLAR BURST OF JUNE 9, 1959 AT DECAMETRIC WAVELENGTHS. Warwick, James W. (Univ. of Colorado, Boulder). Solar Phys., 5: 111-17(Sept. 1968).

A major radio burst at decametric frequencies at 1638 UT on June 9, 1959 is apparently a Type-IV continuum burst of the kind that drifts from high to low frequencies. Observations of flux variations and east–west positions of the emission at both 18 and 38 MHz are presented. The burst moves outward at a speed of about 4700 km·sec^{-1} at each frequency to a height of about 3 $R_\odot$ from the Sun's center and then returns to the Sun. This behavior is not simultaneous at 18 and 38 MHz; the outward moving phase of 18-MHz emission occurs during the return phase of 38 MHz. It is suspected that a solitary Alfvén wave or shock traverses the outer corona at the time of this burst. Relativistic electrons created low in the solar atmosphere travel freely along radial lines of force up to the coronal-streamer heights of the Type-IV burst. Upon encountering the shock, the electrons emit locally intense synchrotron emission, and pass through the shock on out into interplanetary space. This model appears to be consistent with other shock-front phenomena in interplanetary space and the corona. Finally, the Razin effect (Boischot and Clavelier, 1967) suggests that low-frequency cutoffs in Type-IV bursts ought to be quite constant in frequency, and not higher than between 0.4 to 4 MHz. (auth)

52323 THE EXPERIENCE OF USING THE DETERMINED-PROBABILISTIC LEARNING INFORMATION SYSTEM (DPLIS) FOR SOLAR ACTIVITY FORECASTING. Kukushkina, V. P. (Siberian Power Inst., Irkutsk, USSR); Reznikova, A. P.; Druzhinin, I. P.; Kuklin, G. V. Solar Phys., 5: 118-22(Sept. 1968).

The DPLIS and the results of the solar activity cycle No. 20 forecast with the help of it are described briefly. (auth)

52324 THE X-RAY AND EXTREME ULTRAVIOLET RADIATION OF THE AUGUST 28, 1966 PROTON FLARE AS DEDUCED FROM SUDDEN IONOSPHERIC DISTURBANCE DATA. Donnelly, R. F. (Environmental Science Services Administration, Boulder, Colo.). Solar Phys., 5: 123-6(Sept. 1968).

Ionospheric data show that a very large burst of extreme ultraviolet radiation (euv) of about 7 ergs cm^{-2} sec^{-1} above the earth's atmosphere occurred during the proton flare of August 28, 1966. The time dependence of this burst agrees closely with the 8800- and 10,700-MHz solar radio bursts and does not agree with solar radio bursts at frequencies less than 2800 MHz. The soft x-ray enhancement deduced from ionospheric data peaked about 4 min after the euv burst. (auth)

52325 AN EXPLANATION OF THE ELECTRON DENSITY VALUE IN SOLAR FLARES. Banin, V. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Irkutsk, USSR). Solar Phys., 5: 127-8(Sept. 1968).

According to a flare model proposed by the author in 1966, the upper part of the flare is a loop-flare system (LFS) analogous as a whole to the loop-prominence system. From this model an expression is obtained relating the electron density to the electron temperature and the LFS dynamic pressure. Evaluation of the expression gives a value of 10^{13} cm^{-3}, which agrees with the value obtained from observational data. (A.G.W.)

52326 ON THE NATURE OF THE GENERAL MAGNETIC FIELD OF THE SUN. Godoli, G. (Osservatorio Astrofisico di Arcetri, Florence). Scientia (Milan), 101: 213-20(May-June 1966). (In Italian).

Recent studies of the sun are combined to result in a description of the magnetic field of the sun. This is no longer describable in terms of a dipolar field; instead, one must speak of localized polar magnetic fields, which are associated in a general arrangement. Inversion of the solar magnetic field has been shown to correlate with maximum solar activity. Descriptions are given for flares in correlation with localized magnetic behavior; photospheric polar faculae and polar rays have similar epochs of appearance, size, frequency curves, and latitudinal distribution. A general magnetic field of the sun would have to be less than that detectable by a magnetoheliograph, such as 0.1 G. Correlations bearing on the subject of a general magnetic field include polar photospheric facular activity with sunspots and the polarity reversal with increase to a majority of protuberances at high latitudes. The hypothesis that polar magnetic fields are due to migrations of f regions does not exclude the possibility that these are associated in a general order; the ratio of the magnetic flux of the northern hemisphere to that of the southern follows the heliographic latitude of the earth, the polar rays are symmetrically disposed, and there are theoretical considerations as well to support a general ordering. (BBB)

52327 SUNSPOTS. Pikel'ner, S. B.; Livshits, M. A. (State Astronomical Inst., Moscow). Priroda, No. 12, 8-13(Dec. 1967). (In Russian).

The nature of sunspots is reviewed. Their appearance is illustrated, and reduction of temperature across them so that isotherms within the photosphere are raised 300 to 400 km is explained. Weak magnetic fields, often several within the same spot, are noted; their strength has been studied by the Zeeman effect that they produce, and thus has been estimated to be 2000 to 4000 Oe for photospheric observations. In studies of the structure of these fields, values for the Zeeman effect on Hβ and Hα lines gave 2 to 3 times smaller fields at distances 1000 to 2000 km above the photosphere. From such information a map of a typical sunspot is drawn. The magnetic field has maxima and minima, which must be added to static illustrations. Correlations with chromospheric and coronal phenomena may be drawn. On the basis of convection diagrams, a description of temperatures and magnetic-field strength from 0 to 30,000 km above the surface may be drawn. On the surface the field is taken as 3000 Oe, at 20,000 km only 100; the 1000 Oe line is only 2 to 3 thousand km above the surface. Above a spot, the corona is lower; the chromosphere is likewise altered by temperature effects. (BBB)

52328 AN EMPIRICAL MODEL OF SUNSPOT ACTIVITY WITHIN THE LIMITS OF THE SOLAR ACTIVITY CYCLE. Kozhevnikov, N. I. Solar Syst. Res. (USSR) (Engl. Transl.), 1: 134-40(July-Sept. 1967).

An empirical model was developed for the mechanism of sunspot formation on the sun. Basic assumptions are made: In each solar hemisphere there are two toroidal magnetic fields, one of which is of positive polarity, the other of negative. The axes of the tori coincide with the axis of rotation of the sun. The magnetic field of a torus is frozen into matter. The torus floats up into the convective zone in the region of high latitudes and is then carried into the equatorial zone by currents associated with the general circulation. The outflow of the magnetic field to the surface is effected by convective elements. The quantitative deductions from these assumptions are in agreement with observations. The ascending branch of the activity cycle depends both on the interaction between the rising magnetic belt and the matter in the convective zone, as well as on the initial conditions for the formation of the magnetic belt. In the case of the descending branch, however, the initial conditions have practically no effect on the process. The theoretical dependence of R on t is determined. Linear dependence of the width of the sunspot-active region with time is assumed from the model. The results from the model are in satisfactory agreement with observational data. The model therefore in some sense represents the real processes that lead to sunspot formation on the sun. Moreover, since the model is satisfactory, sunspot activity, at least in the first approximation, can be considered independently of the factors leading to the formation of the magnetic field and the periodicity of the activity. (BBB)

52329 DECAMETER RADIO EMISSION FROM JUPITER AND SOLAR ACTIVITY. Sastry, Ch. V. (Astrophysical Observatory, Kodaikanal, India). Planet. Space Sci., 16: 1147-53(Sept. 1968).

It is found that there is an apparent increase in solar activity prior to the emission of decametric radio bursts from Jupiter during years of high solar activity. It is pointed out that Jupiter data contains artificial periodicities due to the observational procedures. The observed correlations between Jupiter radio bursts and solar activity can be explained as being due to the presence of these artificial periodicities in Jupiter data. (auth) (UK)

52330 EXOSPHERIC TEMPERATURES OF JUPITER AND SATURN. McGovern, Wayne E. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 6361-3(Oct. 1, 1968).

This letter conveys the results of model calculations of the exospheric temperature of Jupiter and Saturn as a function of the solar cycle. These computations indicate that the maximum difference between the exosphere and mesopause temperatures in less than 100°K for both planets, compared with approximately 2000°K for the Earth. (W.D.M.)

52331 POWER SPECTRA OF SOLAR RADIO BURSTS AT MICROWAVELENGTHS. Feix, G. (Univ., Bonn). J. Geophys. Res., 73: 6249-57(Oct. 1, 1968).

Measured data of radio bursts at λ = 8.5 mm are given. These radio data and continuously published data at cm wavelengths are compared with the theoretically calculated spectra of synchrotron emission. From this comparison, one may assume that at least 30 to 50 harmonics of a synchrotron process are contributing at mm wavelengths. A weak polarized radiation could be found at λ = 8.5 mm. (auth)

52332 THERMAL ANISOTROPIES AND ELECTROMAGNETIC INSTABILITIES IN THE SOLAR WIND. Kennel, C. F.; Scarf, F. L. (TRW Systems, Redondo Beach, Calif.). J. Geophys. Res., 73: 6149-65(Oct. 1, 1968).

The propagation and stability of right- and left-hand circularly polarized electromagnetic waves propagating along a uniform magnetic field in a hot plasma were investigated. These waves have two instabilities when the parallel particle pressure is larger than the perpendicular: a long-wavelength nonresonant 'firehose' instability, and a cyclotron resonance instability for waves near the ion cyclotron frequency. The growth rates of both instabilities are enhanced when electrons are hot and anisotropic. Both instabilities may have been observed in the solar wind, suggesting by inference that solar wind electrons may indeed be hot and anisotropic. (auth)

52333 EXPLOSIVE IGNITION OF CARBON IN STARS OF INTERMEDIATE MASS. Arnett, W. D. (California Inst. of Tech., Pasadena. Univ. of Cambridge, Eng.). Nature (London), 1344-6(Sept. 28, 1968).

It has been suggested that type-I supernovae are the result of an explosion following the ignition of degenerate nuclear fuel in an evolved star. The purpose of the present communication is to study this suggestion within the context of current stellar evolutionary calculations and to examine development of the instability. Studies of the growth of carbon–oxygen core as a result of He shell burning in stars of intermediate mass indicated that inclusion of energy loss by neutrino emission will prevent the occurrence of carbon flash and that a cold degenerate core of potentially explosive carbon and oxygen will slowly grow; ignition by the $^{12}C + {}^{12}C$ reaction will not occur if the star has a mass less than $\sim 1 M_{\odot}$. This implies that stars which have a less massive carbon–oxygen core at the onset of the He shell-burning stage will not initiate carbon burning by the comparatively gentle carbon flash. The present communication considers how ignition might occur. (UK)

52334 AN OBSERVER MOVING IN THE 3°K RADIATION FIELD. Bracewell, R. N.; Conklin, E. K. (Stanford Univ., Calif.). Nature (London), 219: 1343-4(Sept. 28, 1968).

If an observer in a radiation field observes that the radiation is blackbody of temperature T, then a second observer moving with a velocity V relative to the first will observe a different spectrum, depending on the observing direction. Earlier papers on this subject lead to the implication that the spectrum, as observed by the second observer, is no longer a blackbody spectrum. The purpose of the present communication is to demonstrate classically that in any one direction the spectrum remains that of a blackbody. (UK)

52335 HELIUM LINE STRENGTHS IN THE SPECTRUM OF VARIABLE α-CENTAURI. Norris, J. (Australian National Univ., Canberra). Nature (London), 219: 1342-3(Sept. 28, 1968).

α-Centauri (HD 125823) is a sharp-lined B-type star in which the neutral He lines show a remarkable variation in strength. The investigation described showed that the strength of the He I line λ4471 varied periodically between 300 and 2200 mÅ; all observed He lines also showed extreme variations. Photographic high-dispersion spectra over the wavelength range 3800 to 6700 Å were studied, together with the photoelectric continuum over the range 3300 to 5600 Å. Most of the data were obtained at Mount Stromlo in 1967 and 1968. The period of the He line variations was found to be 8.812 ± 0.004 days. Variation of the equivalent width of He I λ4471 with phase is shown graphically; all other He lines varied in phase with λ4471, but the lines of no other element varied in this way. These findings are discussed. An important finding was that the Balmer jump and the hydrogen line profile, Hγ, are invariant throughout the He line variation. The profiles of He I λ4471 in α-Centauri and χ-Centauri are compared. The basic parameter determining the strength of lines in stellar atmospheres is η_*, the ratio of line to continuum capacity, and for those He lines for which the broadening theory is reasonably well understood, line profiles were computed assuming hydrostatic, radiative, and local thermodynamic equilibrium. It is concluded that changes in the continuum opacity cannot cause the variation—a change in line opacity is required, and either the abundance of He relative to H changes or the levels are populated by some non-LET mechanism; there are difficulties associated with both interpretations. (UK)

52336 RADIO OBSERVATIONS OF FIVE PULSARS. Lyne, A. G.; Rickett, B. J. (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London), 219: 1339-42(Sept. 28, 1968).

Measurements are reported of the positions, periods, dispersions, and pulse shapes of the five new pulsars CP 0328, CP 0808, HP 1506, PSR 1749-28, and PSR 2045-16, at frequencies of 151, 408, and 610 MHz. A remarkable phase stability of the pulses from CP 0328 was demonstrated. Differences in arrival times of the pulses at the three frequencies were measured, and

attributed to different propagation times through an ionised medium, giving a delay proportional to (frequency)$^{-2}$. The measurements also implied that the pulse delays were accurately described by a plasma dispersion law. The pulse to pulse amplitude variations were found to be correlated over a wide frequency range. Deduced values of the integrated electron density in the line of sight between source and Earth are tabulated, together with estimated distances, assuming a mean interstellar electron density of 0.1 cm^{-3}. These distances are up to four times similar estimates for the four pulsars CP 0834, 0950, 1133, and 1919; this finding is discussed. It appeared that sources with low galactic latitudes tend to show high dispersions. It is suggested that the available sample now includes sources from a large section of the Galaxy and not just from the immediate neighborhood of the Sun. Pulse shapes are shown graphically and are discussed; integrated profiles appear to be characteristic for each source and to be independent of frequency. Comparisons are made with results obtained by other observers. All five sources showed similar variability in amplitude to the first four sources. Constancy of period, variability of amplitude, and decreasing flux with frequency appear to be characteristic properties of the sources, but there is at least one source whose flux increases with frequency. Shorter period sources are found to have shorter duration pulses. Plasma dispersions are showing some dependence on galactic coordinates. (UK)

52337 SOLAR EVENTS AT ONE-MILLIMETRE WAVELENGTH. Beckman, J. E. (London Univ.). Nature (London), 220: 52-3(Oct. 5, 1968).

Regions of enhanced variable emission at millimetre wavelengths have been reported on the solar disk. Suggested mechanisms are discussed, and a model is suggested for these sources. Two "hot spots" with a mean brightness temperature 100°K above ambient chromospheric temperature were observed to fluctuate rapidly within their bandwidth of 0.9 to 2.0 mm. These "hot spots" have been identified with filamentary prominences, and a simple prominence model based on optical data has been proposed. Objections to such a model are discussed. A synchrotron explanation is also considered. It is concluded that the events occurred low in the chromosphere, in high H regions. The bursts resembled type-IV radio emission more than type II, differing only in their higher frequency and deeper origin. No observed flare activity was correlated with the millimetric events, but a terrestrial magnetic storm may have been related to the events. No metric or decimetric radiation was recorded during the time of the millimetric events. (UK)

52338 SPATIAL VARIABILITY OF THE SOLAR X-RAY SPECTRUM BELOW 20A. Negus, C. R.; Glencross, W. M. (University Coll., London). Nature (London), 220: 48-50 (Oct. 5, 1968).

Some studies from Skylark rockets are described, scanning a 38-arc-minute square centred on the Sun, and maintaining an instrument lateral axis parallel to the solar equator. Two sets of pictures in the wavelength region 8 to 20 Å on May 5, 1966 and Aug. 8, 1967 were obtained, clearly showing the general features of the x-ray emission below 20 Å. For May 5, 1966 (2 years after solar minimum) it was found that strong emission came from regions of the corona which lay above the plage areas seen in Ca II K radiation. The more intense x-ray emission was associated with the larger plage areas. There was also weak x-ray emission from the plage-free disk, coming predominantly from the northern hemisphere, where initial development of solar activity occurred. By Aug. 1967 strong x-ray emission below 20 Å came from the nonplage area in the southern and northern hemispheres, and the intensity was increased. The regions of enhanced x-ray emission were associated with known centres of activity as shown on the Ca II K spectroheliogram at 3934 Å. The increase in intensity of the slowly varying component of x-ray emission, which occurs as the solar maximum is approached, was caused by an intensification of the emission from the quiet corona and an increase in the number of active regions. The x-ray emission was seen to come from a wide range of heights in the corona. The H Lyman-α emission is produced in the low chromosphere. The method of converting the measured pulse-height distributions into spectra is described. Smooth spectra for two active regions and that of the undisturbed Sun on Aug. 8th are shown. The 15- to 20-Å map, which shows the general features of the x-ray emission, and the Lyman-α contour map, are reproduced. (UK)

52339 IMAGE TUBE OBSERVATIONS OF THE λ 4430 INTERSTELLAR BAND. Brueck, M. T. (Univ. of Edinburgh, Scotland); Nandy, K. N. Nature (London), 220: 46-8(Oct. 5, 1968).

The interstellar absorption band at λ 4430 was examined in a number of high-quality image-tube spectra, which were analyzed by an automated spectrophotometric method and the results computer-reduced. The band profile showed an interesting new feature, consisting of a weak emission band at about λ 4400, to the violet side of the principal absorption band. The spectra are described, together with the method of reduction. It is pointed out that image-tube spectra do not suffer from the difficulty due to variation in emulsion sensitivity which makes it very difficult to define a continuum in photographic work. Also, the highly accurate method used in the analysis and computing work provided a continuum over a range of 600 Å, against which the profile of the interstellar band could be measured more confidently than in photographic spectra, where only a short region of the spectrum can be considered at one time. The image-tube spectra were taken with a 36-inch Cassegrain (f/18) telescope, using a 4-inch grating blazed for the first order, and an f/3 camera giving a dispersion of 40 Å/mm λ 4430. Nine stars were analysed, and the data are tabulated; means were taken to minimise the effect of noise. An asymmetry, and the apparent emission band in the blue wing, were observed. It was found that the ratio of the sizes of the emission to the absorption features could be used as a parameter to provide information as to the size distribution of interstellar grains in different parts of the Galaxy. (UK)

52340 PUMPING MECHANISMS FOR MASER ACTION IN GALACTIC OH. Cook, A. H. (National Physical Lab., Teddington, Eng.). Nature (London), 220: 44-6(Oct. 5, 1968).

Various pumping mechanisms depending on the absorption of radiation have been proposed as competent to invert the Λ doublet of the $^2\Pi_{\frac{3}{2}}$ ground state of the OH molecule and hence to explain the origin of anomalous 18-cm emission from galactic OH as stimulated emission. It is argued in this communication that the available radiation power is likely to be too small for the purpose. (UK)

52341 DISPERSION AND PULSE LENGTH OF THE PULSATING RADIO SOURCE PSR 1749-28. Large, M. I.; Vaughan, A. E. (Univ. of Sydney). Nature (London), 220: 43-4(Oct. 5, 1968).

This pulsar is particularly interesting since it is situated only 2° from the direction of the galactic centre. Observations to determine the frequency drift rate and pulse length are described, using the fan beam of the E-W arm of the Molonglo radiotelescope, at 408 MHz. The pulse amplitude varied randomly within a 5 to 1 range; no significant variation of pulse shape was observed. Data, including physical properties of the pulsar, are shown in tabular form, and a pulse tracing is shown graphically. The frequency drift rate was calculated as 181 ± 10 MHz/sec., and the rms value of the pulse width was 4.7 ± 1 ms. The integrated flux density was measured as ~1 flux unit. It was found that although there is considerable pulse-to-pulse variation, the mean flux density over a number of pulses is reasonably constant. The mean energy per pulse was found to be $\sim 0.5 \times 10^{-26}$ J m^{-2} Hz^{-1}. The pulse duration (~5 ms) is the shortest known. The interstellar dispersion appears to be 2.5 times greater than for any previously reported pulsar. It is established that the pulsar is within the Galaxy, and its distance is estimated as 450 pc; it is one of the strongest known pulsars at 408 MHz. The question of whether the observed dispersion is a valid measure of distance is briefly discussed. (UK)

52342 LOCALIZED INTERSTELLAR MOLECULAR HYDROGEN. Stecher, T. P. (Goddard Space Flight Center, Greenbelt, Md.); Williams, D. A. Nature (London), 219: 1349-50(Sept. 28, 1968).

It is probable that hydrogen molecules have short lifetimes (~1000 yr) in the interstellar radiation field, hence the overall interstellar density of H_2 would be expected to be very low. In localised regions, however, it is possible that H-atoms have been converted to H_2 molecules in the presence of dust. Hydrogen molecules formed by surface reactions on grains may have condensed on to the grain surfaces, so becoming stable against photodissociation. The formation of H_2 molecules in such circumstances is discussed. (UK)

52343 INFRARED SPECTROPHOTOMETRY OF RED GIANT STARS. Wing, Robert Farquhar. Berkeley, Calif., Univ. of California, 1967. 426p.

Thesis.

Red giant stars of all spectral types and degrees of variability were observed photoelectrically through a 30 Å band pass at 27 wavelengths in the range 7500 to 11000 Å. The Lick Observatory prime-focus scanning spectrometer was used at the Crossley and 120-inch telescopes during a two-year period. The observations were used to derive temperatures and indices of the absolute strengths of absorption bands of cyanogen, titanium oxide, vanadium oxide, and zirconium oxide. Infrared apparent magnitudes were measured at 10400 Å, a good continuum point in all late-type spectra. A concurrent program of UBV photometry was conducted at the 24-inch telescope. (Diss. Abstr.)

52344 OBSERVATIONS OF VARIABLE RADIO SOURCES AT 2.8 cm. Medd, W. J. (National Research Council of Canada, Ottawa); Andrew, B. H.; van den Bergh, Sidney. Astron. J., 73: 293-7(June 1968).

A program to monitor the changes in intensity of variable radio sources has been in progress since July 1966 at the Algonquin Radio Observatory of the National Research Council of Canada. The program includes known variable sources, the stronger quasistellar radio sources, and also many sources for which variability is thought possible. These latter sources are almost all quasistellar, and are characterized by features such as flat or unusual spectra, or optical variability. This report summarizes the results of the 2.8-cm observations through October 1967 for 31 sources for which data were obtained. The observations were made with a 46-m dia fully steerable paraboloid. The program was limited to sources having a flux density >1.5 flux units (fu) at 2.8 cm. Flux densities were determined relative to 4 standard reference sources, 3C123, 3C218, 3C274, and 3C348. To examine the possible dependence of variability on spectral type, the spectra were designated as normal, curved, or enhanced according to definitions which are given. The 31 sources are arranged according to these categories, and further classified as to whether variations were observed. Variability was detected in sources with normal spectra. Variability was previously thought to be associated with sources having enhanced spectra, and on the basis of the theory of an expanding cloud of relativistic particles would not be expected in sources having normal spectra. The expanding-cloud model predicts that an enhancement or spectral bulge should move slowly down the spectrum to longer wavelengths, so that at any one wavelength what is observed is first a rise, then a fall in flux density. This explanation does not account for the observations of 3C138 which exhibits a slow decrease with time. According to the expanding-cloud model the end of an outburst is being observed. The spectral bulge associated with this event should therefore be evident at longer wavelengths, but it is not. Therefore, the expanding-cloud theory, while successful in explaining some features of variable sources, is not capable of accounting for all the observations. (BBB)

52345 PROTON-EVENT OF JULY 7, 1966 AS OBSERVED WITH BALLOON-BORNE DETECTORS, SATELLITES, AND NEUTRON MONITORS. Tanskanen, P. J.; Kangas, J. (Univ. of Oulu, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, No. 287, 1-10 (1968).

Observations of protons emitted during the July 7, 1966 solar flare were studied using data obtained with balloon-borne detectors (S 3/66), satellites (Explorer 33 and Alouette II), and ground-based detectors. It is suggested that protons in the energy range E > 100 MeV are, prior to reaching the Earth, accelerated in the interplanetary medium. (auth)

52346 BEHAVIOUR OF WEYL–LEVI CIVITA COORDINATES FOR A CLASS OF SOLUTIONS APPROXIMATING THE SCHWARZSCHILD METRIC. Stachel, J. (Boston Univ., Mass.). Nature (London), 219: 1346-7(Sept. 28, 1968).

The search for energy sources for ultra-high-energy phenomena in astrophysics, for example in quasars and pulsars, has led to renewed interest in the study of general-relativistic gravitational collapse. In the hope that in the late stages of collapse the exterior field of the collapsing object might be well approximated by a static field, Israel (Nature 216: 148(1967)) attempted to prove that there exists a general class of Weyl static, axially symmetric, exterior gravitational fields which deviate arbitrarily little from Schwarzchild's solution for $r > (1 + \sqrt{2})m$, which are analytic except for a particle-like singularity (well within the gravitational radius r = 2m), and which are free of event horizons. In the present communication a need for extreme caution in the use and interpretation of the Weyl coordinates is demonstrated. It is concluded that the application of static results to the problem of gravitational collapse is premature. (UK)

52347 OBSERVATIONS OF CP 1133 WITH A FAST NIGHT SKY CERENKOV DETECTOR. O'Mongain, E. P. (Univ. Coll., Dublin). Nature (London), 219: 1348-9(Sept. 28, 1968).

Attempts were made to detect gamma radiation, or other neutral particles, from CP 1133 in the energy region above 10^{12} eV. The experimental set up was a modified version of that described in Can. J. Phys., Suppl., Paper OG9 (1968). Eleven 40-min scans of CP 1133 were obtained between April 21 and May 2, 1968. A total of 208 showers was observed in 440 min at zenith angles between 37 and 60°, indicating a shower rate of 0.94/min. "on source" and 0.47/min. "off source". Results are shown graphically. The assumption of Poisson statistics appeared valid, although it is pointed out that in night sky Cherenkov experiment fluctuations larger than Poisson values are frequently observed. The estimated flux was about 5×10^{-11} primary photons/cm^2 sec, at an energy threshold of $\sim 3 \times 10^{12}$ eV. The possibility that the apparent effect was due to flashes of light in the source itself, produced by some process analogous to an air shower, could not be ruled out. (UK)

52348 TIME DIRECTION AND COSMOLOGY. Jegerlehner, Friedrich (Univ., Bern). Fortschr. Phys., 16: 137-93(1968). (In German).

The relations between the time directions characterized in physics are explained in the framework of cosmology. General considerations on thermodynamic reversibility, electrodynamic retardation, and expansion of the Universe and their relations are given. The permitted elementary time asymmetry, which is realized in nature, is used as a discussion basis. A general argument makes irreversibility and retardation appear as two aspects of a single characterized time direction. Since the thermodynamic formalism affects many unsolved problems, no accurate analysis on the relation between irreversibility and cosmology can be carried out. A model can be given for the relation between retardation and cosmology. This model is discussed. It is shown that a local time-symmetrical electrodynamics in an expanding Universe can be formulated by consideration of the cosmological boundary conditions. This gives a valid model which describes accurately the observed retardation. (tr-auth)

52349 ELECTRON-IMPACT BROADENING OF LINES OF SiII/III, SII/III, CII, AND MgII. Brechot-Sahal, S. (Observatoire de Paris, Meudon, France). Z. Astrophys., 69: 74-7(Aug. 1968). (In German).

The electron impact broadening of 13 astrophysically important ion lines is calculated according to the theory of Bréchot and Van Regemorter. The temperatures are chosen as 10,000, 15,000, and 20,000°. (auth)

52350 OBSERVATIONS OF OH EMISSION IN W3, NGC 6334, W49, W51, W75, AND ORI A. Weaver, Harold; Dieter, Nannielou H.; Williams, David R. W. (Univ. of California, Berkeley). Astrophys. J., 16: Suppl. Ser. 146, 219-74(Sept. 1968).

All members of the quartet of OH radio lines in five H II regions, which exhibit anomalous OH radio emission in the principal lines, were observed. The observations were made with the 100-channel Hat Creek receiver (operating at spectral resolution of 2 kHz) in conjunction with the 85-foot antenna equipped with a linearly polarized feed. The complex of very narrow spectral features comprising one "line," the total lack of similarity of line shape among the members of the OH quartet arising from one H II region, and the unpredictable intensity ratios among the four lines in one source are all clearly shown. Characteristic relations between the lines of the anomalous OH emission, the OH absorption, and the excited hydrogen (all originating in one H II region) are tentatively suggested. The H II regions involved with the OH emission are described and the sharply point-source nature of the OH regions from which the anomalous emission arises is indicated. Two characteristics of H II regions in which anomalous principal-line emission is present appear to be regions of very high emission measures and, in those H II regions visible in the optical range, close association with dense obscuration. The pointlike OH-emitting regions, few in number and apparently closely clumped together in the case of any one H II region, show no position preference over the projected surface of the nebula. It is noted that in NGC 6334 the clumped OH emitters are in two quite different regions of the nebula. The OH emission is strongly polarized, primarily circularly, with no apparent preference for left- or right-handedness. Linear polarization, less frequently observed than circular, is nevertheless strong in some sharp components. The percentage and character of the polarization change very rapidly with frequency as one moves from one narrow component to another within a line. Over the time period covered by the observations reported it is found that some narrow spectral components in the principal lines of NGC 6334 and Ori A vary in intensity, in some instances by much more than 100%. The characteristic time of the intensity variation ranges from days to months. Some portions of a line, that is, some groups of the narrow features, appear to be particularly active in intensity variation. In discussing the intensity variations, possible instrumental causes of the fluctuations are considered and it is concluded that the observed intensity fluctuations are real, traceable to the emitting regions in the nebulae. Finally, the properties of the sources observed are summarized and a variety of observations relating to OH emission on which further work would be particularly valuable are pointed out. (auth)

52351 SCIENTIFIC USES OF PULSARS. Counselman III, Charles C.; Shapiro, Irwin I. (Massachusetts Inst. of Tech., Cambridge). Science, 162: 352-5(Oct. 18, 1968).

The recently discovered celestial sources of pulsed radio en-

ergy can be used to test general relativity, to study the solar corona, and to determine the Earth's orbit and ephemeris time. The vector positions and transverse velocities of pulsars can be measured with radio interferometers; in combination with pulse-arrival-time data, the distance determination will yield the average interstellar electron density. (auth)

52352 GALAXIES AS GRAVITATIONAL LENSES. Barnothy, J.; Barnothy, M. F. Science, 162: 348-52(Oct. 18, 1968).

Of all the galaxies in the visible part of the Universe, 500 million are seen through intervening galaxies. In some instances the foreground galaxy will act as a gravitational lens and produce distorted and (in brightness) greatly amplified images of the galaxy behind it; such images may simulate starlike superluminous objects such as quasars. The number of gravitational lenses is several times greater than the number of quasars yet observed. In other instances the superposition of the image upon a visible foreground galaxy may simulate morphological configurations resembling N-type, dumbbell, spiral, or barred-spiral galaxies. (auth)

52353 THE RADIATION OF THE SOLAR PHOTOSPHERE FROM 2000 A TO 100 μ. Labs, Dietrich; Neckel, Heinz. Z. Astrophys., 69: 1-73(Aug. 1968).

Topics included in this compendium include the 20-Å integrals Σ_i, Φ_i, and Θ_i of the central intensity I_λ, the mean intensity F_λ, and the irradiance H_λ, respectively, for the spectral region from 3300 Å to 1.25 μ; calibration of the photometric atlases; the solar continuum from 3000 Å to 100 μ; observational aspects about the "continuum windows" below 4000 Å; the line blanketing coefficient η; the solar irradiance and the spectrophotometric solar constant; central and mean intensities from 7000 Å to 2.5 μ; the pyrheliometric solar constant; and the solar continuum from 4000 to 8000 Å and the "window" intensities below 4000 Å. (W.D.M.)

52354 PREDICTED PERFORMANCE OF A ROTATING MODULATION COLLIMATOR FOR LOCATING CELESTIAL X-RAY SOURCES. Schnopper, H. W.; Thompson, R. I.; Watt, S. (Massachusetts Inst. of Tech., Cambridge). Space Sci. Rev., 8: 534-42(Sept. 1968).

A method of determining the position of celestial x-ray sources which utilizes a modulation collimator rotating about a fixed axis is presented. The signal from each source in the field of view is modulated by a frequency which is fixed by the radial distance from the intersection of the rotation axis and the celestial sphere. The phase of the modulation is determined by the angular distance of the source from a reference line on the celestial sphere. Thus, the modulation function for each source is unique. The data are reduced by the technique of Fourier analysis. Synthesized experimental data for the cases of a single source and for five sources in the field of view are analysed. The ability to distinguish and accurately locate each source in a multiple source field is a major achievement of this method. Sources can be located with an accuracy which is competitive with other methods. An experiment based on this method can be lifted on an Aerobee 150 system. (auth)

52355 STELLAR EVOLUTION. IX. THE FIRST HYDROSTATIC CONTRACTION PHASE OF A STAR OF 1 SOLAR MASS. von Sengbusch, Kurt (Max-Planck-Institut fuer Physik und Astrophysik, Munich. National Aeronautics and Space Administration, New York). Z. Astrophys., 69: 79-111(Sept. 9, 1968). (In German).

It is generally presumed (Hayashi, 1961) that stars are fully convective and have an adiabatic temperature stratification during their first hydrostatic contraction. Changes in the evolutionary features which will occur if these two assumptions are not valid were investigated. It turns out that hydrostatic evolution of a star which has overadiabatic temperature stratification throughout is possible only near the Hayashi-border in the Hertzsprung–Russell diagram. On the other hand it does not seem possible that a star of low mass ($M \lesssim 1\ M_\odot$) can avoid a fully convective evolutionary phase even if it possibly had partly a convective stable temperature stratification when it reached hydrostatic equilibrium after gravitational collapse. (auth)

52356 BRIGHTNESS DISTRIBUTION AND STRUCTURE OF THE GALAXY. Neckel, Thorsten (Landessternwarte, Heidelberg). Z. Astrophys., 69: 112-29(Sept. 9, 1968). (In German).

A model of the Milky Way is derived from the Elsässer and Haug brightness distribution data. It contains values for the volume emission in the spiral arms near the Sun and the density distribution in the galactic disk. It has been confirmed that in some directions the light from large distances (~10 kpc) contributes to the measured surface brightness. An absolute magnitude of $M_v = -21.1$ and $M_p = -20.5$ has been calculated in agreement with the magnitudes of the Sb-spiral galaxies. The volume emission of the Sun's neighborhood, $\epsilon = 0.049$ stars $(M \approx 5)/pc^3$ in blue, is in agreement with the integral of the van Rhijn luminosity function. The increase of the volume emission in the galactic disk in the direction of the center is not as steep as the density distribution of the Schmidt mass model. For this reason a larger value ($\mathcal{M}/L = 14$) is obtained for the mass–luminosity ratio of the disk near the center as in the sun's neighborhood ($\mathcal{M}/L = 7.25$). All calculations are based on the absorption values from Neckel, which were computed with an absorption/color excess ratio $R = 3.1$. It is shown that the large R values from Johnson are not reasonable because they do not allow a representation of the brightness distribution in the Milky Way. (auth)

52357 NEW INFRARED STARS. Ackermann, G.; Fugmann, G.; Hermann, W.; Voelcker, K. (Landessternwarte, Heidelberg). Z. Astrophys., 69: 130-9(Sept. 9, 1968). (In German).

First results are reported of a photographic–photoelectric program on infrared stars. The stars were identified by objective prism spectra, photographed on Kodak IN plates with 25- and 40-cm Schmidt telescopes. The dispersion at the atmospheric A band was 4500 and 3200 Å/mm, respectively. These stars were measured with a photoelectric photometer at $\lambda = 0.9\ \mu$(I) and $\lambda = 2.2\ \mu$(K) with the 70-cm reflector of the Landessternwarte Heidelberg. Thirteen new objects have been measured now with $I - K \geq 3^m.5$. Three stars are known Mira variables, some stars seem to be reddened. The objects with great color index ($I - K \geq 4^m$) seem to be concentrated to the galactic plane. (auth)

52358 ARE QUASAR REDSHIFTS DISTANCE-DEPENDENT? Pfleiderer, J. (Institut fuer Astrophysik, Bonn). Z. Astrophys., 69: 140-5(Sept. 9, 1968).

Visually bright quasars tend to be faint in the radio range and vice versa. The geometric mean of the fluxes at 178 MHz and in the optical range is a function of the redshift z with low scatter ($0^m.6$) which indicates that z is a distance indicator. If this is true, then z-dependent evolution effects must occur in any model of quasar origin. The relative intensities at 178 MHz, 1410 MHz, and in the optical range are, however, not systematically dependent on z. (auth)

52359 POLYTROPIC STARS WITH VERY STRONG MAGNETIC FIELDS. Monaghan, J. J. (Lick Observatory, Santa Cruz, Calif.). Z. Astrophys., 69: 146-53(Sept. 9, 1968).

The structure of polytropic stars with very strong magnetic fields is determined using an improved perturbation method. The calculations show that all polytropes with $n \geq 2.5$ are grossly distorted when the magnetic energy is several percent of the gravitational energy. It is also found that the magnetic field is an insensitive function of the polytropic index. Detailed results are presented for the polytrope of index 3. (auth)

52360 PRECESSION OF A ROTATING MAGNETIC STAR. Monaghan, J. J. (Lick Observatory, Santa Cruz, Calif.). Z. Astrophys., 69: 154-9(Sept. 9, 1968).

The precession of a rotating, magnetic polytrope was formulated for the case where a perturbation treatment is valid. For the polytrope of index 3 the precession frequency was evaluated and found to be unobservable unless the fields are at least two orders of magnitude greater than those observed. (auth)

52361 OPTICAL IDENTIFICATION AND INTERPRETATION OF X-RAY SOURCES. Oda, Minoru (Tokyo Univ.). Space Sci. Rev., 8: 507-33(Sept. 1968).

Evidence related to the optical identification of Sco X-1 in historical order is briefly reviewed. An optically thin hot plasma, adopted as a working hypothesis to search for the optical counterpart, is still favored as a model of x-ray emitters. Numerical aspects of this model are discussed. The system that may produce and contain the hot plasma is suggested to be a close binary from optical features of the object. Properties of Tau X-1 and Cyg X-2 are discussed in relation to Sco X-1. (W.D.M.)

52362 MODULATION COLLIMATOR IN X-RAY ASTRONOMY. Bradt, H. (Massachusetts Inst. of Tech., Cambridge); Garmire, G.; Oda, M.; Spada, G.; Sreekantan, B. V.; Gorenstein, P.; Gursky, H. Contracts NASw-1284; NASw-1535; NSG-386; AT(30-1)-2098. Space Sci. Rev., 8: 471-506(Sept. 1968).

Modulation collimators have been used in recently reported work to determine the angular sizes and celestial positions of the x-ray sources Sco X-1 and Taurus XR-1 (Crab Nebula) with precisions of 15″ to 30″. The measurements were made by means of four-grid collimators, star photography, and optical imaging of the collimators. A discussion is presented on (1) the principles and uses of various forms of the modulation collimators as they pertain to x-ray astronomy, (2) several methods for determining the celestial positions of x-ray sources with these collimators, (3) the techniques for the alignment and calibration of these

detection systems, (4) an image-forming collimator, and finally, (5) some of the optical properties of these grid systems. The modulation collimator is quite versatile and is particularly suited for measurements from spacecraft with relatively poor pointing capability. Thus it should be a useful tool in x-ray astronomy for some years to come. (auth)

52363 CLUSTERS OF GALAXIES. Abell, George O. (Univ. of California, Los Angeles). Postepy Astron., 16: 250-77(1968). (In Polish).

Basic facts about regular and irregular clusters of galaxies and a short history of the problem are given. The problem of establishing the magnitudes of galaxies forms a material difficulty in investigation of clusters of galaxies. Galaxies are nebulous objects, thus classical methods of photographic and photoelectric star photometry are not suitable. It is impossible to measure the total light of elliptical galaxies by any method but there exists a possibility of establishing certain representative magnitudes in a system which is self-consistent and independent on the distance. The luminosity function thus obtained grows monotonically. Other difficult problems are that of dimensions of cluster and also that of the level of the background galaxies which is connected with the former one. Both can be solved by some hypothetical assumptions only. A segregation between bright and faint galaxies inside clusters was found. This proves stability and rather long age of clusters. Careful application of virial theorem leads to the conclusion that the mass/luminosity ratio for clusters amounts to about 100. Thus the total mass contained in the dark intergalactic matter inside of clusters is of the same order as or lower than the mass of cluster galaxies. (auth)

52364 QUASARS. Zonn, Wlodzimierz. Postepy Astron., 16: 237-47(1968). (In Polish).

A report delivered during the Meeting of the Polish Astronomical Society at Wroclaw, October 1967, devoted chiefly to the interpretations of the red shifts of quasars and their connections with radio galaxies and galaxies is summarized. (auth)

52365 THEORETICAL MODELS OF SUPERNOVAE. Paczynski, Bohdan. Postepy Astron., 16: 223-36(1968). (In Polish).

The recent achievements in supernova models are reviewed. (auth)

52366 ABSOLUTE MAGNITUDES AND INTRINSIC COLOURS OF WOLF–RAYET STARS. Smith, Lindsey F. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc., 140: 409-33(1968).

Results of five-color narrow band photoelectric observations are given for forty-three Wolf–Rayet (WR) stars in the Magellanic Clouds and for seventy-seven WR stars in the Galaxy. Photometric classification criteria are established and most WR stars in the Magellanic Clouds are classified. Absolute magnitudes are found to be correlated with spectral subclass; among the WN stars, those in the lowest excitation subclasses are the most luminous. It is found that the WR stars in the Large Magellanic Cloud are very similar to stars of the same spectral subclass in the Galaxy. However, subclasses WC6, WC7, WC8 and WC9 are completely absent from the Magellanic Clouds, and WN6 stars are rare. The relationship between absolute magnitude and spectral appearance of the WC5 + OB stars and the WN4 + OB stars is consistent with the hypothesis that these are binary systems in which WR stars, similar to single stars of the same type, are associated with O or B stars. (auth)

52367 DISSOCIATION–IONIZATION FRONTS IN INTERSTELLAR GAS CLOUDS. I. PHYSICAL PROCESSES. Mendis, D. A. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 435-43(1968).

The effects of ultraviolet radiation from early type stars on clouds of molecular hydrogen are considered. The reactions taking place within the front are discussed and it is concluded that whichever way the reactions proceed the effective transition is: $H_2 \rightarrow 2H \rightarrow 2H^+ + 2e$. The dissociation and ionization take place within a single thin region which is called a dissociation–ionization front. Microscopic processes within the dissociation–ionization front are investigated and it is shown that, while good thermalization exists between the translational and rotational modes of the different species, the vibrational mode of the molecules remains "frozen" throughout the front. Consequently collisional dissociation within the front is insignificant. The effects of radiation pressure and of magnetic and gravitational forces are seen to be unimportant in the treatment of the fronts. This paper clears the ground for a subsequent one on the structure and the propagation of dissociation–ionization fronts in interstellar gas clouds containing molecular hydrogen. (auth)

52368 PLANE SYMMETRIC COSMOLOGICAL MODEL. Singh, K. P.; Singh, D. N. (Banaras Hindu Univ., India). Mon. Notic. Roy. Astron. Soc., 140: 453-60(1968).

A plane symmetric perfect fluid cosmological model has been derived from class-one considerations. The pressure and density are found to be decreasing functions of time and lines of flow are geodesics. The coordinate system used turns out to be a co-moving system. The spatial cross section of the Universe at any given instant of time is flat. When the model represents a Universe filled with disordered radiation it reduces to a particular case of the Lemaître Universe. From the consideration of geodesic deviation it is concluded that the Universe is expanding with time. The fourteen scalar invariants of the second order for the line-element have been evaluated and it is found that only two of them are independent. The Lemaître Universe is conformal to flat space–time while this model is not so in general and hence it is not a special case of the Lemaître Universe. The line element admits a four-parameter group of motions. (auth) (UK)

52369 RELATIVISTIC COSMOLOGICAL MODELS WITH BOTH RADIATION AND MATTER. McIntosh, C. B. G. (Univ. of New England, Armidale, New South Wales). Mon. Notic. Roy. Astron. Soc., 140: 461-72(1968).

The general theory is given for relativistic cosmological models which contain a mixture of radiation (pressure = $\frac{1}{3}$ radiation energy density) and dust (pressure zero) and which change from radiation like models for early time to dust like models for recent time. The basic parameter of the models is $\epsilon(t)$, the ratio of the pressure to the matter energy content of the Universe. ϵ thus changes from $\frac{1}{3}$ at t = o to o for large t. Special models are developed in which the initial rate of absorption of radiation by the dust is greater than the rate of emission and in which the present rate of emission is greater than the rate of absorption. These models have $\epsilon = \frac{1}{3}(1 + \mu t)^{-a}$ where μ is a positive constant and, for flat space, $o < a < \frac{2}{3}$. These models have a radiation dominated early stage, a matter dominated present stage, a present value of radiation equivalent to that from a black-body at 3°K and rates of emission and absorption of radiation near the observed values and are thus reasonable models of the Universe. The best value of a is about $\frac{7}{11}$. (auth) (UK)

52370 CALCULATION OF STELLAR RADIATIVE OPACITY. Carson, T. R.; Mayers, D. F.; Stibbs, D. W. N. (University Observatory, St. Andrews, Scotland). Mon. Notic. Roy. Astron. Soc., 140: 483-536(1968).

A new algorithm, suitable for large-capacity high-speed digital computers, for the evaluation of stellar radiative opacity is presented. The method is designed specifically for application to mixtures of a large number of elements in arbitrary proportional concentrations. (auth) (UK)

52371 RADIO METHOD FOR DETERMINING THE ASTRONOMICAL UNIT. Williams, D.; Davies, R. D. (Univ. of Manchester, Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 537-46(1968).

The Astronomical Unit is obtained by measuring the Doppler shift relative to the Earth of the narrow spectral features of galactic neutral hydrogen at 21 cm. The features chosen were the narrow absorption components in the spectra of Cassiopeia A, Taurus A, and the emission at $l^{II} = 0.7°$, $b^{II} = 0.0°$. Observations which were taken over the period of one year gave two largely independent estimates of the Astronomical Unit which were combined to yield a value of 149,635,000 ± 19,000 (p.e.) km. This agrees with the value adopted by the IAU based on the radar value but it disagrees with the value determined optically by Rabe (1965) using a dynamical method. (auth) (UK)

52372 AXISYMMETRIC DYNAMO. Cowling, T. G. (Univ. of Leeds, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 547-8 (1968).

The axisymmetric dynamo model recently proposed by Jayanthan is shown to be inadmissible because it requires the existence of sources and sinks of material. (auth) (UK)

52373 INTERACTION OF STELLAR WIND WITH DIFFUSE NEBULAE. Pikel'ner, S. B. (Moscow State Univ.). Astrophys. Lett., 2: 97-9(Oct. 4, 1968).

High-velocity motions observed in diffuse nebulae may be connected with stellar wind. The wind forms a two-layer shell between two shocks. The inner layer is the rarified high-temperature gas of the wind. Its pressure depends on the inner shock radius and effectively supports the motion of the shell. The radiative cooling of the inner layer is insignificant. The temperature of the outer layer decreases to the standard value for a nebula. This layer becomes thin and dense. Spectral lines of ions should be a little more intensive than in surrounding nebula. The pres-

sure of the high-temperature gas can effectively compress condensations and globulae. (auth)

52374 INFRARED EMISSION OF NGC 7027. Goldberg, L. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Lett., 2: 101-4(Oct. 4, 1968).

It is suggested that the strong infrared emission found by Gillett, et al. (1967) in the spectrum of NGC 7027 may be accounted for by discrete line emission. The major sources of emission lines appear to be magnetic dipole transitions between fine-structure levels of the ground terms of p-electron and d-electron configurations, with a small admixture of hydrogen recombination lines. The intensity and spectral distribution of the line emission are strongly dependent on the temperature and density, which may explain the varying appearance of the emission in other sources. (auth)

52375 DEPENDENCE OF RATIO SOURCE COUNTS AND THE SPECTRAL INDEX DISTRIBUTION ON FREQUENCY. Kellermann, K. I.; Pauliny-Toth, I. I. K.; Davis, M. M. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett., 2: 105-11(Oct. 4, 1968).

The dependence of the radio source counts and the spectral index distribution on observing frequency is derived. The results of surveys at 1400 MHz (CTD), 2700 MHz (Parkes), and 5000 MHz (NRAO) are compared with the expected distributions, calculated from the results of surveys at 178 MHz. No significant difference between the computed and observed source counts or spectral index distributions are found except at low flux levels at 5000 MHz, where there may be an excess of sources with flat spectra. (auth)

52376 PENCIL-BEAM DEEP SKY SURVEY AT 408 MHz. Grueff, G.; Vigotti, M. (Laboratorio Nazionale di Radioastronomia, Bologna). Astrophys. Lett., 2: 113-20(Oct. 4, 1968).

The results of a preliminary survey made with the Bologna cross-type radio telescope which was recently brought into full operation are reported. The log N−log S curve of the radio sources between 2.0 and 0.25 flux units has a slope of 1.5. The average spectral index over the range 178 to 408 MHz for sources with $S_{408} \geq 1.1$ flux units is −0.60. (auth)

52377 REDISCUSSION OF POSSIBLE MODELS FOR NOVAE. Friedjung, M. (Institut d'Astrophysique, Paris). Astrophys. Lett., 2: 121-6(Oct. 4, 1968).

Fresh arguments are given which make instantaneous ejection models for novae extremely improbable. The most probable forms of continued ejection models are also briefly discussed from a new standpoint. (auth)

52378 NEUTRINO VISCOSITY IN COSMOLOGICAL MODELS. Stewart, J. M. (Cambridge Univ., Eng.). Astrophys. Lett., 2: 133-5(Oct. 4, 1968).

The viscous effects of neutrinos in anisotropic cosmological models were examined using a Boltzmann equation with a simple collision term. The original results of Misner (1968) are correct only when the anisotropy is small at the viscous epoch; for large anisotropies neutrinos are ineffective in reducing the shear. (auth)

52379 SPECTRUM OF THE 6 MARCH 1968 SOLAR RADIO BURST. Michael, G. A. (Air Weather Service, Ent AFB, Colo.); Clark, W. D.; Francis, A. A.; Castelli, J. P. Astrophys. Lett., 2: 137-9(Oct. 4, 1968).

An unusual decimeter burst peaking near 1000 MHz was observed on the Sun on 6 March 1968 at the Sagamore Hill Solar Radio Observatory in Hamilton, Massachusetts. Power spectral indices in the high- and low-frequency directions were respectively +8 and −12. The spectral shape and magnitude of the power spectral index are not indicative of proton emission. It is suggested that the event is an example of the Razin effect. (auth)

52380 DETAILED PHOTOMETRY OF THE JET IN MESSIER 87. De Vaucouleurs, G.; Angione, R.; Fraser, C. W. (Univ. of Texas, Austin). Astrophys. Lett., 2: 141-6(Oct. 4, 1968).

Detailed photometry of three high-resolution photographs of the M87 jet, taken in blue light at the Cassegrain focus of the 82-inch reflector at the McDonald Observatory (scale 1 mm = 7.45 arc sec), gives by photoelectric calibration a total B magnitude m = 15.8 ± 0.1, or M = −14.9 if m−M = 30.7. Comparison of the luminosity profiles of the brighter condensations A, B, C in the jet (m = 16.77, 17.23, 17.90) with stellar profiles on the same plates indicates that the knots are not distinguishable from point sources. Assuming gaussian profiles for the stars and the unresolved sources, an upper limit of 0.33 arc sec can be placed on the half-power diameter of the sources. This is less than 20 pc, if the distance of M87 is 12 Mpc. (auth)

52381 RADIATION DIFFUSION IN A PLANE LAYER WITH ANISOTROPIC SCATTERING. II. Minin, I. N. (Leningrad State Univ.). Sov. Astron. AJ (Engl. Transl.), 12: 209-18(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 264-78(Mar.-Apr. 1968).

The problem of radiation diffusion in a plane layer with nonspherical phase function is considered using a probabilistic approach. The case of the simplest nonspherical phase function of the form $1 + x_1 \cos\gamma$ is studied in detail. (auth)

52382 SOME EXTREMAL PROPERTIES OF MASSIVE SPHERES IN GENERAL RELATIVITY. Kovetz, Attay (Tel-Aviv Univ., Israel). Astrophys. J., 154: 241-50(Oct. 1968).

The extreme values of the central pressure and the minimal value of the central temperature in a spherical configuration are determined in accordance with general relativity. It is shown that finite central pressure requires $R > \frac{9}{8} R_s$, where R is the radius of the configuration and $R_s = 2GM/c^2$ is its Schwarzschild radius, and that finite central temperature requires $R > 1.549 R_s$. (auth)

52383 THE DETERMINATION OF STAR DIAMETERS WITH THE HELP OF THE DISTORTION OF THE FRESNEL DIFFRACTION FIGURE IN THE COVERAGE BY THE MOON. PART II. Rakos, Karl D. (Univ., Graz. Lowell Observatory, Flagstaff, Ariz.). Acta Phys. Austr., 26: 289-307(1967). (In German).

The equations for the determination of the apparent diameter are derived. The measurement techniques are described. The observational results are tabulated and their implications are discussed. (J.S.R.)

52384 LAGRANGE AND JACOBI IDENTITIES FOR A STELLAR SYSTEM: CONFIGURATION OF STARS AND DIFFUSE MATTER. Bouvier, Pierre (Observatoire, Geneva). Ann. Inst. Henri Poincare, Sect. A, 8: 241-51(1968). (In French).

The Lagrange and Jacobi identities are written for an inviscid and perfectly conducting gaseous configuration sprinkled with stars. An increase of the upper threshold value of the magnetic field for stability is obtained and the conditions for applying these considerations to the stability of a galactic arm are further discussed. (auth)

52385 COVARIANT DECOMPOSITION AND ENERGY OF A GRAVITATIONAL FIELD. Deser, S. (Institut Henri Poincare, Paris. Brandeis Univ., Waltham, Mass.). Ann. Inst. Henri Poincare, Sect. A, 8: 269-73(1968). (In French).

The covariant decomposition of a symmetric tensor leads, for systems with a moment of time symmetry, to a transparent derivation of the result that the energy of the gravitational field is positive definite. More precisely, it is shown that the energy as a function of the geometry, has only one extremum—flat space—about which it is positively defined. (auth)

52386 NONTHERMAL OPTICAL RADIATION FROM GALAXIES. Demoulin, Marie-Helene; Burbidge, G. R. (Univ. of California, San Diego). Astrophys. J., 154: 3-20(Oct. 1968).

There is now observational evidence for nonthermal optical flux from the galaxies M87, M82, NGC 1068, NGC 4151, 3C 120, 3C 371, 3C 390.3, and 3C 109. Estimates of the total flux emitted and its spectral energy distribution have been made from the observations. Upper limits to the size of the radiating regions have been deduced from the variations of many of the sources. The energetics have been calculated for the three possible emission mechanisms: the electron and the proton synchrotron processes and Compton scattering. If the electron synchrotron process operates in the small sources, the minimum magnetic fields are ~0.1 gauss, greater than the equipartition value; total energies in particles and field are given for a variety of assumptions. If the proton synchrotron process operates, the magnetic fields must be much stronger, $\sim 10^3$ gauss, the proton energies are $\sim 10^{14}$ eV, and the minimum total energies are 10^3 to 10^4 times those for the electron synchrotron process, while the Compton effect is negligible; however, the ambient gas density must be $\lesssim 10^4$ particles cm^{-3}. If the optical flux is Compton radiation generated by the interaction of high-energy electrons with an intense radiation field of lower frequency (some part of the high-frequency radio flux), the process is found to be highly inefficient, since a large flux of electrons is required and only a small fraction of their energy will be transferred in the time taken to cross the source. This process is open to observational test, since in most cases a much larger flux of harder radiation (x rays or γ rays) will be generated. It is concluded that the electron synchrotron process is likely to be the most efficient for the generation of the nonthermal optical flux. Observations in many frequency ranges (radio, infrared, optical, and x ray) of the same sources and their variable properties may enable us to eliminate some processes. Finally, a comparison is made between these galaxies and quasi-stellar

objects. It is shown that the similarities between QSOs and Seyfert and N-type galaxies do not support either the local or the cosmological interpretation of the QSOs. In either case the properties are continuous. (auth)

52387 ENERGY DISTRIBUTIONS, K CORRECTIONS, AND THE STEBBINS–WHITFORD EFFECT FOR GIANT ELLIPTICAL GALAXIES. Oke, J. B.; Sandage, Allan (Carnegie Inst. of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 154: 21-32(Oct. 1968).

The energy distribution $F(\lambda)$ in the range 3350 Å $\leq \lambda \leq$ 5850 Å has been measured with a spectral resolution of 50 Å for a number of nearby giant E and S0 galaxies and for M31 and M32. The distribution in the near-infrared to λ = 10,800 Å has been obtained for NGC 3379 and NGC 4472. The various distributions, apart from that for M32, are nearly identical and have been averaged to obtain a standard $F(\lambda)$ from which new K_B, K_V, and K_R corrections for the effects of redshifts are calculated. New observations of B−V colors for the several brightest galaxies in thirty-one clusters, covering the redshift range $0 < z \leq 0.20$, are listed. The observed color change with redshift is shown. Agreement of the observations with the predicted color change, $K_B - K_V$, shows, following an earlier result by Whitford, that the Stebbins–Whitford effect is absent to the 3% level in the broad-band B−V system and that no variation of the shape of $F(\lambda)$ with time is present larger than that implied by $\Delta(B-V) \leq 0.03$ mag for redshifts as large as $z = 0.20$. The shape change of $F(\lambda)$ because of evolution of the stellar content in the lookback time must, therefore, be below the limit of present detectability. (auth)

52388 PHYSICAL CONDITIONS IN THE NUCLEI OF M51 AND M81. Peimbert, Manuel (Univ. of California, Berkeley). Astrophys. J., 154: 33-48(Oct. 1968).

Narrow-band photoelectric photometry of the nuclei of M51 and M81 was carried out with the Crossley and the 120-inch telescopes at Lick Observatory. The intensity of several emission lines, as well as of the continuum at different wavelengths, was obtained. From the [O I], [O II], and [O III] line intensities, it was found that collisions by thermal electrons are not responsible for the ionization in M81 and M51. This result, coupled with the observed Balmer decrement in M81, led to the adoption of radiation as the principal mechanism of ionization. The radiation field needed to explain the intensity of Hα in M51 and M81 was computed for three black-body temperatures. The predicted contribution of such a radiation field to the integrated observed flux in the most favorable wavelengths of the visual region was found to be very small. Large density fluctuations were found in the nuclei of M51 and M81 by comparing the N_e(λ3727) density with the N_e(rms) density. From the intensity of the [O I] λ6300 line, it was found that a large fraction of the material in these nuclei is in the neutral form. Solar abundances cannot explain the relative line intensities in the nuclei of M51 and M81. Several arguments are presented which suggest an overabundance of nitrogen in the nuclei of both galaxies. From these arguments it was concluded that most of the variation of the N II/Hα intensity ratio from the spiral arms to the nuclei of both galaxies is caused by a change of the nitrogen abundance and not by a change of electron temperature. (auth)

52389 DYNAMICAL STATE OF THE INTERSTELLAR GAS AND FIELD. IV. EVOLUTION OF THE DISK OF INTERSTELLAR GAS. Parker, E. N. (Univ. of Chicago). Astrophys. J., 154: 49-55(Oct. 1968).

It is shown that ambipolar diffusion, enhanced by the dynamical instability of the interstellar gas–field system, may permit the escape of a significant portion of the interstellar magnetic field from the disk of the Galaxy during the 10^{10}-year life of the Galaxy. The result is a decrease in the scale height or thickness of the gaseous disk. (auth)

52390 DYNAMICAL STATE OF THE INTERSTELLAR GAS AND FIELD. V. REDUCED DYNAMICAL EQUATIONS. Parker, E. N. (Univ. of Chicago). Astrophys. J., 154: 57-72(Oct. 1968).

The dynamical equations for a gas suspended on a horizontal magnetic field are simplified and reduced by supposing that the Alfvén speed is large compared with the thermal velocity and that the scales are small compared with the scale height. The simplification renders the equations tractable in more complicated physical situations than the complete set of hydromagnetic equations used in some of the earlier investigations. A number of results for hydrostatic equilibrium, and for small perturbations of an equilibrium, are worked out to illustrate the properties of the approximate system of equations. Comparison with the special cases treated from the complete equations indicates that most of the essential features of the dynamics appear to be retained by the simplified equations. The simplified equations are to be applied to more complicated cases in future papers. (auth)

52391 RADIO DISTANCES OF GASEOUS NEBULAE. Higgs, L. A.; Ramana, K. V. V. (National Research Council, Ottawa). Astrophys. J., 154: 73-86(Oct. 1968).

The observed flux density at radio frequencies of a radiation-bounded gaseous nebula is directly proportional to the ultraviolet luminosity of the exciting stars and is inversely proportional to the square of its distance. Hence a knowledge of the properties of the exciting stars can be used to derive a "radio distance" to the nebula. A comparison of this value with an optically determined distance indicates whether or not the nebula is in fact radiation-bounded. The nebulae observed in a 10-cm survey of galactic radio emission in Cassiopeia and Cepheus ($100° < l^{II} < 140°$) are subjected to this analysis. Good agreement is found between radio distances of the sources and photometric distances of the associated exciting stars for eleven of fourteen sources. Of the remainder, two appear to be density-bounded nebulae while one (3C 58) seems to be a nonthermal source. These results support the usual assumption that the majority of gaseous nebulae are radiation-bounded. A table of the probable exciting stars is given and the approximate positions of the nebulae in the Galaxy are indicated. (auth)

52392 He I λ10830 LINE IN PLANETARY NEBULAE AND THE ORION NEBULA. Vaughan, Arthur H. Jr. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 154: 87-101(Oct. 1968).

Interferometric observations of profiles of He I λ10830 emission lines in eleven planetary nebulae and in selected regions of the Orion Nebula are presented. In common with the Orion Nebula, the planetaries are shown to emit a P Cygni-like λ10830 line, with the absorption shifted toward the violet with respect to the laboratory wavelength in a frame of reference at rest in the center of expansion of the gas. The emission is shifted toward the red. In planetaries, the negative displacements of the absorption edges are, in general, approximately equal to the widths, β, of the emission components which, in turn, range from about 12 km sec^{-1} in I 418 to about 28 km sec^{-1} in NGC 6210. The emission redshift is about 0.7 β on the average, but individual shifts vary from 0.5 β in II 2149 to 1.05 β in NGC 6826. The line widths and shifts tend to increase in nebulae with larger expansion velocities. In Orion, the absorption edges in the λ10830 line coincide in velocity with those in the line He I λ3888 observed against the spectra of the Trapezium stars. In planetaries, the absorption edges in the λ10830 line appear qualitatively similar to those in the line He I λ3888, but a coincidence in velocity could not be demonstrated. The observed profiles indicate that the nebulae are expanding or that they contain expanding globules or filaments. Some form of circumnebular absorbing zone may be indicated. However, it is suggested that frequency redistribution associated with resonance-like scattering in a homogeneous expanding medium might in principle (even in the absence of stratification) account for the shifted λ10830 profiles. No trace of ^{3}He is evident from the profiles. Quantitative conclusions are uncertain without a model that reproduces most of the phenomena, but an upper limit of $^3He/^4He \leq 0.05$ or even 0.01 is suggested on the basis of conservative assumptions. (auth)

52393 NEUTRAL HYDROGEN IN THE VICINITY OF OPEN CLUSTERS. Gordon, Courtney P. (National Radio Astronomy Observatory, Green Bank, West Va.); Howard III, William E.; Westerhout, Gart Astrophys. J., 154: 103-13(Oct. 1968).

H I observations of twenty-eight open clusters, having optical diameters ≤20′ and $-0.34 \leq (B-V)_T \leq +0.40$, were made with the National Radio Astronomy Observatory 300-foot telescope (beam width 12′) and the 100-channel autocorrelation receiver (velocity resolution 2 km sec^{-1}). No attempt was made to associate large-scale features (≥1° in angular size) with a cluster; rather, detailed correlations between the cluster and features of the H I gas (either maxima of minima) in the immediate vicinity of the cluster were sought. The anticipated location of the associated H I feature in velocity space was taken to be the optically determined stellar radial velocity, when available, or otherwise the velocity calculated using a galactic-rotation model. On the average, a cloud of ≥30 $M_\odot$ should be detectable (≥1 to ≥200 $M_\odot$ in the best and worst cases, respectively). At the position and velocity of some clusters (especially NGC 581, 663, 744, and 1893), hydrogen maxima or minima are found, but there are no more of these cases than would be expected on the basis of chance. For the average cluster the amount of associated neutral hydrogen, if it is present at all, is certainly less than one-third its total stellar mass. (auth)

52394 CORRELATION BETWEEN THE REGIONAL VARIATIONS IN WAVELENGTH DEPENDENCE OF INTERSTELLAR EXTINCTION AND POLARIZATION. Serkowski, K. (Australian National Univ., Canberra). Astrophys. J., 154: 115-34(Oct. 1968).

The ratio of the amount of interstellar polarization in the yellow spectral region to that in the blue (or ultraviolet) is well corre-

lated with the ratio of color excesses E_{V-I}/E_{V-R}. The maximum of polarization is shifted toward longer wavelengths for the higher values of the ratio R of total to selective extinction. A formula is given for estimating R from the ratio of the amount of polarization in the yellow to that in the blue spectral region. A pronounced wavelength dependence of position angles of polarization was found for several stars, confirming Gehrels' and Silvester's results. Polarization not exceeding 0.0005 mag was found for the seventeen stars nearer than 10 pC observed with the 24-inch rotatable telescope of Siding Spring Observatory. A large percentage of emission-line B-type stars show intrinsic polarization diminishing in the ultraviolet more sharply than does the interstellar polarization. (auth)

52395 MEASURED EXTINCTION EFFICIENCY OF GRAPHITE GRAINS. Donn, B.; Hodge, R. C.; Mentall, J. E. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 154: 135-7 (Oct. 1968).

Normalized extinction efficiencies were measured for graphite particles whose mean diameters were less than 0.1 μ. Good agreement was found between the gross behavior of the measured extinction curves and Mie theory. The experimental curves, however, exhibited a considerable amount of structure which is presumably due to quantum effects. (auth)

52396 RAPID CHANGES IN THE OPTICAL INTENSITY AND RADIAL VELOCITIES OF THE X-RAY SOURCE SCO X-1. Westphal, J. A.; Sandage, Allan; Kristian, Jerome (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 154: 139-56(Oct. 1968).

The optical flux of Sco X-1 was continuously monitored on five separate nights between April and June 1967. Pulse counting was used with sampling intervals of 5 sec on the 100- and 200-inch telescopes and 15 sec on the 60-inch reflector. The error due to photon statistics per sample interval was smaller than 0.007 mag in all cases. The data were processed entirely by computer, using a variety of special digital techniques. Rapid optical flickering with amplitudes of ~0.02 mag on a time scale of minutes was found on all five nights. These high-frequency fluctuations are superposed on slower continuous variations with amplitudes ~0.15 mag, and on occasional bursts of 0.2 mag which last about 10 min with very short rise and decay times. Radial velocities were measured by a digital method of cross-correlation of microphotometer records of the original photographic plates (Westphal 1966). Velocity changes of about 100 km sec^{-1} were found on two different singly trailed plates, each of 3 hours' duration. The hydrogen lines and He II (λ4686) change in opposite directions, similar to the extar Cyg X-2, suggesting, but not proving, binary motion. Systematic changes of velocity from night to night are set out. The distance to Sco X-1 is estimated to be $D \simeq 500$ pC by three methods, based on the strength of interstellar Ca II K, and on the old nova hypothesis. A firm lower limit of $D \geq 300$ pC seems well established. The total x-ray power is $\simeq 2 \times 10^{37}\ h^2$ ergs sec^{-1}, where h is the distance in units of 500 pC. If the x-ray energy is due to bremsstrahlung, this level requires Sco X-1 to continuously pump energy into the hot plasma, replenishing the entire energy store of gas in the cooling time of $t_c = 3 \times 10^{-15}\ h^{-1}\ R^{\frac{5}{2}}$ sec where *R is the radius (in centimeters) of the plasma system.* Reasonable values of 10^{11} cm $< R < 10^{12}$ cm give 100 $h^{-1} < t_c <$ 3000 h^{-1} sec, which, remarkably, is the characteristic time of the light flicker. Mechanical energy due to some type of low-Q oscillation of the system, similar in many respects to that observed in the Sun, seems capable of providing 10^{37} ergs sec^{-1} to the plasma gas. The crucial experiment remains to simultaneously monitor the optical and the x-ray flux over periods of several hours. Detailed correlation of fluctuations is not expected, but the mean x-ray flux might plausibly be expected to vary in periods of fractions of an hour as the mean amplitude of the optical fluctuations changes. (auth)

52397 IMAGE-TUBE SPECTROSCOPIC STUDIES OF RAPID VARIABLES. I. SPECTROSCOPIC AND PHOTOMETRIC OBSERVATIONS OF SS CYGNI. Walker, Merle F.; Chincarini, Guido (Univ. of California, Santa Cruz). Astrophys. J., 154: 157-78(Oct. 1968).

Single-trail spectroscopic observations of SS Cygni demonstrate that the rapid, irregular light variations at minimum result entirely from changes in the intensity of the continuum; the emission-line intensities are unchanged. Observations during the rise to maximum of the 4-mag nova-like outbursts show the absorption spectrum characteristic of this phase and demonstrate (1) that the outburst is associated with the hot star and (2) that at least up to *the observed phase of the outburst no appreciable expansion of the* photosphere has occurred. The observations reveal a hitherto undetected doubling of the K line of Ca II. At minimum the K line is (occasionally) double in emission, probably because of a rotating ring or shell of material surrounding the hot star. During the rise to maximum of the 4-mag outbursts, the K line is double in absorption. Apparently the rise to maximum is accompanied by a large increase in Ca II emission, the hydrogen emission remaining constant. The orbital period of the system is found to be increasing linearly with time, the rate of increase corresponding to a mass loss of $1.8 \times 10^{-7}\ M_\odot\ year^{-1}$. This is much larger than the value of $7 \times 10^{-9}\ M_\odot\ year^{-1}$ derived by Gaposchkin for the mass ejected during the 4-mag outbursts, so that continual mass loss through the second Lagrangian point of the binary system appears to dominate. (auth)

52398 ANALYSIS OF F AND G SUBDWARFS. III. AN ABUNDANCE ANALYSIS OF THE SUBDWARF μ CASSIOPEIA. Cohen, Judith G. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 154: 179-84(Oct. 1968).

Equivalent widths of lines with $\lambda > 4600$ Å were measured from a set of 4.5 Å mm^{-1} Palomar plates and were used in performing a model-atmosphere abundance analysis of the mild subdwarf μ Cas. Comparison with the Sun was made by computing abundances from individual solar lines using the same set of transition probabilities as was used for the subdwarf. Results of this analysis show that the iron-peak element appear to be deficient by a factor of 4, while the a process in μ Cas elements may be enhanced with respect to these elements. (auth)

52399 ISOTOPES OF MAGNESIUM IN STELLAR ATMOSPHERES. Boesgaard, Ann Merchant (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 154: 185-90(Oct. 1968).

High-dispersion coudé spectrograms (3 to 4 Å mm^{-1}) of ten late-type stars of all luminosity classes were taken to determine the isotopic abundances of ^{25}Mg and ^{26}Mg relative to ^{24}Mg from the (0,0)-band of MgH near 5211 Å. A computer program was used that determines line profiles from a simple exponential radiative-transfer model and includes the blending effects of nearby lines and both Doppler and instrumental broadening. Profiles were computed for several different isotope ratios and were compared with direct-intensity microphotometer tracings of the spectrograms. It is found that ^{25}Mg and ^{26}Mg are certainly present in these stars and may be slightly enhanced over their terrestrial abundances. (auth)

52400 REDISCUSSION OF ECLIPSING BINARIES. VIII. THREE SYSTEMS WITH UNEQUAL MAIN-SEQUENCE COMPONENTS. Popper, Daniel M. (Univ. of California, Los Angeles). Contract Nonr-3507(00). Astrophys. J., 154: 191-202(Oct. 1968).

CM Lac, V477 Cyg, and TV Cet are main-sequence eclipsing binaries in each of which the spectrum lines of the smaller, cooler component can be measured only with difficulty. Good photometric orbits are available for the first two systems, but not for TV Cet. The available data are analyzed to obtain the masses, radii, and colors of the components. The observed flux ratios of the components of both CM Lac and V477 Cyg are greater than predicted from the colors by about 30%. The components of both systems appear to be unevolved and to fall on the Sun–Sirius mass–luminosity relation. These properties cannot be studied for *TV Cet because of the lack of suitable photometry.* (auth)

52401 NON-LINEAR PULSATIONS OF DISCRETE STELLAR MODELS. I. FIRST-ORDER ASYMPTOTIC THEORY OF THE ONE-ZONE MODEL. Usher, Peter D. (Harvard Coll. Observatory, Cambridge, Mass.); Whitney, Charles A. Astrophys. J., 154: 203-14(Oct. 1968).

This paper presents equations describing pulsations of arbitrary amplitude in a one-zone model of a star. The properties of the model are defined by dimensionless parameters whose physical significance is discussed. The asymptotic method is used to examine the secular variations of amplitude and phase for almost-linear oscillations. The model is used to elucidate the physical bases of two features of stellar pulsation: (1) the small change of period with decreasing amplitude shown recently by the star RU Cam and (2) the wide range of phase relations between luminosity and displacement shown by pulsating stars of various types. (auth)

52402 VARIATION OF GLOBULAR-CLUSTER CHARACTERISTICS WITH AGE. Rood, Robert; Iben, Icko Jr. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 154: 215-24(Oct. 1968).

Time-constant loci relevant to an understanding of metal-poor clusters are presented, and age-dependent relationships between *the horizontal-branch portions and the turnoff portions of the* theoretical loci are compared with the observations. It is shown that the NGC 7006 "anomaly," which has been interpreted by Sandage and Wildey as an indication of a considerable variation in initial helium abundance, can also be understood in terms of

a variation in globular-cluster ages. If there is no appreciable variation in initial helium abundance, a variation of $(1-2) \times 10^9$ years in globular-cluster ages is required to account for the anomaly. The possibility that cluster stars might have been formed over an interval that is large compared to the present rotation period of the Galaxy leads to a re-evaluation of an argument to the contrary. An estimate of the mean age of galactic globular clusters is found to be in accord with an estimate by Iben and Faulkner. The effect of including postulated neutrino losses is shown to be a reduction in estimated mean cluster age (from 9×10^9 to 8×10^9 years) and a reduction in estimated initial helium abundance (from $Y \sim 0.33$ to $Y \sim 0.30$). (auth)

52403 NUCLEOSYNTHESIS BY THE s-PROCESS IN STARS OF 9 AND 15 SOLAR MASSES. Peters, James G. (Indiana Univ., Bloomington). Astrophys. J., 154: 225-40(Oct. 1968).

Evolutionary sequences of models of 9 and 15 $M_\odot$ stars are combined with the details of the $^{22}Ne(a,n)^{25}Mg$ neutron-source reaction and of the neutron-capture processes to determine the abundances of heavy elements produced by the s-process of stellar nucleosynthesis. The central temperatures become high enough for neutron production when the convective core shrinks in mass. At the end of core helium burning, the material of the core remnant exhibits an exposure to neutrons which increases toward the center. Taking the 9 $M_\odot$ model as a standard, three variations are considered: (1) a minimum-source reaction rate, (2) an increased source-to-seed ratio, and (3) an increased mass (15 $M_\odot$). Although a distribution of exposures is produced in each case, the maximum exposures are less than that of solar system material. The f(A) curves (product of the neutron-capture cross-section and of the abundance of a nuclide of atomic mass A) which would result from mixing various portions of the core remnant with unprocessed envelope material are compared with the f(A) curves of solar system material and of the Ba II stars. (auth)

52404 RELATIVISTIC, SPHERICALLY SYMMETRIC STAR CLUSTERS. I. STABILITY THEORY FOR RADIAL PERTURBATIONS. Ipser, James R.; Thorne, Kip S. (California Inst. of Tech., Pasadena). Astrophys. J., 154: 251-70(Oct. 1968).

There is some indication that very dense star clusters might play important roles in quasi-stellar sources and in the nuclei of certain galaxies. The roles of such star clusters should be strongly influenced by a relativistic instability, which sets in when a cluster surpasses a certain critical density. In this paper the groundwork is laid for the study of that instability: the theory of small, radial perturbations of a spherically symmetric star cluster is developed within the framework of general relativity. The cluster is idealized as a solution to the collisionless Boltzmann–Liouville equation (an idealization which should be valid on the short time scale associated with the relativistic instability). The equation of motion governing small radial perturbations is derived and is shown to be self-conjugate. From the equation of motion follows a variational principle for the normal modes, which provides a necessary and sufficient condition for the stability of the cluster. Also presented are (1) the corresponding Newtonian analysis, much of which has been developed previously by Antonov and by Lynden–Bell, (2) the relationship between the Newtonian and relativistic analyses, and (3) necessary and sufficient conditions for the existence of a zero-frequency mode of radial motion. (auth)

52405 NON-LTE DIAGNOSTIC STELLAR SPECTROSCOPY. I. CONCEPTUAL AND ANALYTICAL BACKGROUND. Gebbie, K. B.; Thomas, R. N. (Joint Inst. for Laboratory Astrophys, Boulder, Colo.). Astrophys. J., 154: 271-283(Oct. 1968).

An approach to the determination of the state of a stellar atmosphere is outlined and those regions where thermodynamic equilibrium state parameters can be adopted either because collisional processes dominate or because the radiation field satisfies certain homogeneity conditions are delineated. It is regions satisfying these homogeneity conditions that must be used to determine the boundary values for the state parameters of the LTE interior. The observable regions of a star do not in general satisfy these conditions, and for these layers an alternative approach to specifying the state parameters and the analytical basis for determining their values is summarized. This paper then provides the background for the specific applications in succeeding papers. (auth)

52406 NON-LTE DIAGNOSTIC STELLAR SPECTROSCOPY. II. ON THE SCHUSTER MECHANISM FOR THE PRODUCTION OF EMISSION LINES. Gebbie, K. B.; Thomas, R. N. (Joint Inst. for Laboratory Astrophysics, Boulder, Colo.). Astrophys. J., 154: 285-96(Oct. 1968).

The conditions under which the Schuster mechanism can produce emission lines are investigated. Schuster's original formulation is considered, together with Milne's modification and a general non-LTE formulation. It is concluded that while emission lines may result in particular circumstances, it is unlikely that observations of bright lines can be interpreted by this mechanism. (auth)

52407 WAVES IN THE SOLAR ATMOSPHERE. I. THE ACOUSTIC ENERGY FLUX. Stein, Robert F. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 154: 297-306(Oct. 1968).

An extension of Lighthill's theory of aerodynamic generation of sound to stratified atmospheres is used to calculate the upward acoustic energy flux from the solar convection zone. The result is 2×10^7 ergs cm^{-2} sec^{-1}. In addition the frequency spectrum of the emitted flux is obtained. It rises as ω^n $(1 < n < 2.5)$ above the critical frequency $\omega_1 = \gamma g/2c$, reaches a maximum in a few octaves, and then falls off rapidly. Acoustic emission is very sensitive to the turbulent velocities, and Böhm–Vitense' mixing-length theory gives only a rough model of the solar convection zone. It is also sensitive to the high-frequency tail of the turbulence spectrum. The form of the turbulence energy spectrum is not known and may, in fact, depend on the emission and absorption of acoustic waves. This lack of knowledge yields an uncertainty in the calculated acoustic flux of about an order of magnitude. (auth)

52408 NUCLEAR-CHARGE SPECTRA AND ENERGY SPECTRA IN THE SEPTEMBER 2, 1966, SOLAR-PARTICLE EVENT. Durgaprasad, N.; Fichtel, C. E.; Guss, D. E.; Reames, D. V. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 154: 307-15(Oct. 1968).

Heavy nuclei ($Z \geq 3$) were detected in the September 2, 1966, solar-particle event. This brings to five the number of events in which these particles have been detected. The proton energy spectrum was measured down to energies as low as 3 MeV and up to energies as high as 100 MeV, with measurements on the helium and heavier nuclei covering a more restricted range. The relative abundances of helium, light $(3 \leq Z \leq 5)$, medium $(6 \leq Z \leq 9)$, and heavier nuclei obtained in this experiment in the energy range from about 14 to 35 MeV $nucleon^{-1}$ agree with those measured in previous solar-particle events at higher energies and hence with those of the solar photosphere. This result strengthens the concept of a multicharged nuclear composition, which is a characteristic of solar-particle events. Use of the recent solar spectroscopic data and the ratio of helium to medium nuclei observed in solar cosmic rays results in a hydrogen-to-helium ratio of 16 ± 2. An examination of the relative abundances of protons and medium nuclei shows that the propagation of solar particles in this event cannot be described by a simple diffusion model with a diffusion coefficient proportional to β or βR. (auth)

52409 ABUNDANCE OF HYDROGEN IN THE ATMOSPHERE OF JUPITER. Owen, Tobias; Mason, Harold P. (Illinois Inst. of Tech., Chicago. Kitt Peak National Observatory, Tucson, Ariz.). Contracts NASr-65(17); NASr-65(19). Astrophys. J., 154: 317-26 (Oct. 1968).

New observations of the hydrogen quadrupole absorptions in the spectrum of Jupiter are presented. With the help of a recently published curve of growth and new calculations of the line strengths, it is possible to derive the corresponding atmospheric abundance of hydrogen. The result is based on the observation of two lines that give nearly identical values: 85 km amagat for 3–0 S(1); 90 km amagat for 4–0 S(1). These results appear to be consistent with observations of other lines in the quadrupole bands, and it is demonstrated that they are compatible with other determinations of the hydrogen abundance. A comparison of methane and hydrogen abundances suggests that the relative abundances of the elements in the Jovian atmosphere are similar to, if not identical with, solar values. This suggestion is consistent with observed line half-widths. Multiple scattering may be invoked to explain a number of observations, but it is evident that variations in the gross structure of the clouds with position on the observable hemisphere must also play a significant role in determining the optical behavior of the Jovian atmosphere. (auth)

52410 SEARCH FOR STELLAR CARBON DIOXIDE. Carleton, Nathaniel P.; Liller, William; Roesler, Fred L. (Harvard Coll. Observatory, Cambridge, Mass. Univ. of Wisconsin, Madison). Astrophys. J., 154: 385-7(Oct. 1968).

High-resolution spectral scans of α Herculis made with a Pepsios pressure-swept triple Fabry–Pérot interferometer failed to reveal any carbon dioxide in the star's atmosphere. This note gives an upper limit of 4 mÅ to the equivalent of the searched-for lines of the $\nu_1 + 2\nu_2 + 3\nu_3$ band at 1.05 μ and an upper limit of 1.4×10^{22} molecules cm^{-2} to the abundance of CO_2. (auth)

52411 SEARCH FOR LINE EMISSION FROM SINGLY IONIZED HYDROGEN MOLECULES. Penzias, Arno A. (Bell Telephone Labs., Holmdell, N. J.); Jefferts, Keith B.; Dickinson, Dale, F.; Lilley, A. Edward; Penfield, Hays. Astrophys. J., 154: 389-90(Oct. 1968).

A search for line emission from singly ionized hydrogen molecules was made in the vicinity of 1405 MHz with negative results. This was done with the Harvard–Smithsonian 85-foot paraboloid at Agassig Station, fitted with a parametric amplifier radiometer with a 200°K system temperature. A number of sources were investigated over the frequency range indicated with a frequency resolution of 100 kHz/sec. The sources selected were chosen because of their intense H II or OH spectra. (W.D.M.)

52412 DISCUSSION OF THE SIZES AND EXCITATION OF H II REGIONS. Rubin, Robert H. (National Radio Astronomy Observatory, Green Bank, West Va.). Astrophys. J., 154: 391-5 (Oct. 1968).

The generality of the relation between radio flux density, distance, and the ionizing radiation producing a nebula is demonstrated. Previous estimates for the size of H II regions for some stars of early spectral type must be revised downward when current model atmospheres rather than black-body atmospheres are used to represent the emergent flux. (auth)

52413 COMMENTS ON THE POSSIBILITY OF INTERSTELLAR QUARTZ GRAINS. Wickramasinghe, N. C.; Swamy, K. S. Krishna (Inst. of Theoretical Astronomy, Cambridge, Eng. Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 154: 397-400(Oct. 1968).

The interstellar extinction curve cannot be reproduced with quartz particles or quartz core–ice mantle particles. The condensation of quartz in M-star atmospheres requires temperatures ~1000°K, which are lower than the boundary temperatures of these stars. (auth)

52414 HEATING OF THE SOLAR CORONA. D'Angelo, N. (Research Establishment, Riso, Denmark). Astrophys. J., 154: 401-3(Oct. 1968).

The suggestion is advanced that heating of the solar corona may result from Landau damping of ion–acoustic waves generated in the photosphere. (auth)

52415 STUDY OF NORMAL GALAXIES AT 1415 MHz. II. STRUCTURE AND EVOLUTION OF NORMAL GALAXIES. Nguyen-Quang-Rieu (Observatoire de Meudon, France). Ann. Astrophys., 31: 401-12(July-Aug. 1968). (In French).

A galaxy model based on the assumption of the diffusion of particles in an inhomogeneous galactic magnetic field is calculated. The magnetic field is supposed to be constant over a characteristic length l and parallel to the plane of the galaxy. This structure is assumed to exist in spiral and irregular galaxies. The electrons diffuse slightly perpendicularly to the field direction, but practically follow the lines of force so that one is dealing with an anisotropic diffusion. A cylindrical symmetry is considered, with a radial diffusion coefficient $D_{\parallel}$ in the plane of the galaxy greater than $D_{\perp}$, the one in the transverse direction. $D_{\parallel}$ is taken as 3×10^{28} cm^2 s^{-1}. This value corresponds to a characteristic length $l \sim 1$ pC. The assumed average magnetic field is 5×10^{-6} gauss. The radio electrons are supposed to be the primary electrons ejected from the nucleus of the galaxy; their spectrum is given the power law $KE^{-\gamma}$ with $\gamma = 2.2$. For the sake of simplicity, consideration is limited to the case of the diffusion in an infinite medium; only the losses by synchrotron radiation and inverse Compton effect are taken into account. (auth)

52416 SPECTRAL TYPE RELATIONS, EFFECTIVE TEMPERATURE, AND COLORS (METAL CONTENT OR MICROTURBULENCE) FOR O. C. WILSON STARS OF SPECTRAL TYPE G5 AND K3. Rousseau, Jeanine (Univ., Lyon). Ann. Astrophys., 31: 413-43(July-Aug. 1968). (In French).

The large scatter that is observed when the colors (P–V) are plotted against O. C. Wilson's spectral types, gave rise to different interpretations. The purpose of this paper is to test the interpretations given by O. C. Wilson, Pagel, Cayrel, and Jugaku, on the basis of six-color observations of O. C. Wilson's stars. (auth)

52417 INITIAL-VALUE PROBLEM FOR GRAVITATIONAL COLLAPSES. Occhionero, F. (Laboratorio di Astrofisica, Rome). Ann. Astrophys., 31: 361-5(July-Aug. 1968).

By bearing in mind that the hydrodynamical problem for linear radial motions in stars is of the third order with respect to time, it is possible to convert the physical fact triggering a collapse into a precise initial condition, which determines uniquely the shape of the initial inward motion. (This is the case also for general-relativistic problems.) It is then easy to show that, under very general conditions, in the spectral decomposition of the initial motion in normal modes, it is always the fundamental mode to bring the greatest part of the burden: a collapse starts as an overall inward implosion. (auth)

52418 EVOLUTIVE TRACKS OF MIXED STARS. Masani, A. (CNR, Milan); Borghese, P.; Ferrari, A.; Gallino, R. Ann. Astrophys., 31: 367-78(July-Aug. 1968).

In recent years the astronomer's attention was drawn by the stars which lie on the left of the main sequence of the Hertzsprung–Russell diagram (planetary nebulae, Wolf–Rayet stars, etc.). Suitable models for these stars were treated by different authors, for instance by Roy, Hayashi, Salpeter, Cimino, etc.; but still they lack completeness. The aim of this work is to give a full treatment of the evolutive tracks of stars, which, leaving the main sequence, evolve homogeneously and shift towards the above region of the H–R diagram. The results obtained are shown in an extensive diagram. (auth)

52419 ORIGIN OF BINARIES FROM A STATISTICAL STUDY. Huang, Su-shu (Northwestern Univ., Evanston, Ill.). Ann. Astrophys., 31: 379-85(July-Aug. 1968).

Different statistical distributions of binary separations have been derived on various assumptions. A comparison of these results with the observed distribution indicates that stars may indeed be formed in groups. However, a discrepancy between the observed and calculated distributions at large values of separations persists in all models that assume the formation of each binary from a single condensation. It is therefore suggested that binaries with large separations might be formed by capture at the time of their formation or in the process of dissociation of a star cluster. The mechanisms that two or more stars may emerge from a single condensation are suggested in the last section. (auth)

52420 STUDY OF NORMAL GALAXIES AT 1415 MHz. I. OBSERVATIONS OF NORMAL GALAXIES AT 1415 MHz. De la Beaujardiere, O.; Kazes, I.; Le Squeren, A. M.; Nguyen-Quang-Rieu (Observatoire de Meudon, France). Ann. Astrophys., 31: 387-99(July-Aug. 1968). (In French).

Observations of normal galaxies were made with the Nancay telescope in order to detect their structure. The half-power beam width is 4′ in the east–west direction and varies from 22′ to 30′ in the north–south direction. 135 galaxies were observed and 56 detected. The histogram of the ratio r/o of the half-power radio width in the east–west direction to the corresponding Holmberg optical diameter which represents the overall optical dimension, is drawn. Two classes of galaxies seem to appear on this histogram. The first one corresponding to the central peak at $r/o = 0$ includes galaxies the radio dimension of which is very small compared to the optical dimension; this suggests that the radio emission comes mainly from the nucleus. The second class which extends from beyond the central peak to $r/o \sim 0.5$ includes all galaxies the radio diameter of which is comparable to the optical diameter. As shown in Paper II this may be explained by an evolution effect. The cutoff beyond $r/o = 0.5$ suggests that the halos are not detected for most of the observed galaxies. Nevertheless, in a few cases the small extension beyond $r/o = 0.5$ may be due to the existence of the halo or more probably to the confusion effect rather important at this flux limit, or to an underestimation of the optical diameter due to galactic absorption. (auth)

52421 SOME CHARACTERISTICS OF TYPE-IV RADIO BURSTS. I. DESCRIPTION AND INTERPRETATION OF BURSTS OF SEPT. 14, 1966. Boischot, A.; Clavelier, B. (Observatoire de Paris, Meudon, France). Ann. Astrophys., 31: 445-55(July-Aug. 1968). (In French).

On September 14, 1966, a flare was observed on an active center located 10° behind the west limb, and was accompanied by different radio bursts. The sources of the emissions were studied on two frequencies with high-resolution equipment, and this study leads to several important results concerning the mechanism of acceleration of electrons and the conditions for synchrotron emission in the corona. Two different type-IV bursts were observed, the first between 10h 38m and 10h 45m, and the other between 11h 02m and 11h 20m (U.T.); characteristics of each are discussed. (auth)

52422 B-EMISSION STARS AND GALACTIC ROTATION. Crampton, David (Univ. of Toronto). Astron. J., 73: 338-47 (June 1968).

Radial velocities of 203 early type Be stars within 1.5 Kpc of the Sun were derived from a critical examination of published material and from new observations and measurements. An examination of the absolute magnitudes of the Be stars confirmed Schmidt–Kaler's calibration. Least-square solutions for the solar-motion and galactic-rotation parameters yielded the following results: $U_\odot = -5.3 \pm 1.9$ km/sec, $V_\odot = +12.7 \pm 2.1$ km/sec, $A = 11.8 \pm 1.9$ km/sec, $K = -2.0 \pm 1.8$ km/sec. Evidence is presented that the radial velocity system for Be stars does not contain any large errors, either systematic or random in nature. It

is shown that nonuniform longitude distribution of a sample of stars can bias the value determined for Oort's constant A especially if the adopted solar motion is not suitable for the stars considered. The value of the U_0 component (−5.3 km/sec) of the solar motion derived from the Be stars indicates that the commonly adopted local standard of rest has a systematic outward motion. (BBB)

52423 STUDIES OF VISUAL DOUBLE STARS. I. Meisel, David D. (Leander McCormick Observatory, Charlottesville, Va.). Astron. J., 73: 350-60 (June 1968).

In the study reported, 66 visual double stellar systems were investigated to obtain rotational velocities, MK spectral types, and, where possible, absolute magnitudes. A master list of ~1200 pairs was compiled by cross-referencing the Index Catalogue of Double Stars 1961.0 (ICDS) of Jeffers, et al., with a number of special lists. Systems involving O- and B-type stars, supergiants, Be stars, Ap stars, and variable stars constituted the primary groups of interest. Some visual pairs involving eclipsing binaries, spectroscopic binaries, and high-velocity stars were also included. On the basis of mutual incompatibility of interstellar line intensities, Hγ equivalent widths, radial velocities, and proper motions (where available), 16 of the 66 systems were judged to be optical and rejected for further study. Absolute magnitudes using Am's were obtained for 43 companions. For early-type stars, absolute magnitudes on the Petrie system were also determined from photographic equivalent widths of Hγ. The results are compared with the MK calibrations of Keenan and of Blaauw. Comparison of absolute magnitudes derived in 2 ways for the same stars indicated mean deviations M_v (Δm's) minus M_v (Hγ) of −1.0 ± 0.2 (m.d.) for 4 stars of types O6−O8 and +1.1 ± 0.2 (m.d.) for 4 stars of types B0−B2 and classes II and III. For 10 Be stars, a mean M_v (Δm) minus M_v (MK main sequence) of −1.0 ± 0.2 (m.d.) was obtained, in agreement with previous results. Average values of V sini and probable errors were obtained for each component with apparent rotational velocity greater than 50 km/sec. The new results were combined with those previously obtained by Slettebak. In agreement with his earlier result, no significant difference of (V sini) between single and double stars was found although the total sample was enlarged by 20%. The combined results (both double and single stars) were used to derive new ⟨V⟩ and σ(V) for early-type MK stars. (BBB)

52424 A SEARCH FOR GAMMA RAYS FROM THE CRAB NEBULA USING A DIGITIZED SPARK CHAMBER. Kniffen, Donald Avery. Washington, D. C., Catholic Univ. of America, 1967. 139p.

Thesis.

The detector developed for this investigation is a digitized spark chamber. The detector is mounted in an oriented gondola and flown by balloon above all but a small amount of the Earth's atmosphere. Analysis of the data consists of examining each event recorded during the flight for pair-production events. The celestial arrival direction of each gamma ray is estimated by the bisector of the pair. The construction of the chamber with many thin plates alternated with the spark modules also allows a determination of the gamma-ray energy at 30 to 250 MeV by the multiple scattering technique. Though no celestial source of gamma rays was detected, upper limits of 2.2 and 1.8×10^{-4}/cm² sec were obtained for photons from the Crab nebula with energies $30 \leq E_\gamma \leq 100$ and $E_\gamma > 100$ MeV, respectively. The differential and integral energy spectra of gamma rays produced in the atmosphere at a depth of 3 g/cm² were obtained in the 30 to 250-MeV energy range. In view of the theoretical predictions presented, it appears that chances of detecting a point source of gamma rays in a balloon-borne experiment are poor. However, a long term satellite exposure should be able to detect an observable signal, and a detector of the type described here appears to be the best choice for such a search. (Disser. Abstr.)

52425 DISPERSION OF SPECTROGRAMS IN CONNECTION WITH ABUNDANCE RATIO DETERMINATION OF ^{12}C TO ^{13}C IN CARBON STARS. Fujita, Yoshio (Tokyo Univ.). Proc. Jap. Acad., 44: 495-500 (June 1968).

Some infrared lines are adequate for the determination of isotopic C abundance in C stars. This spectral region should be carefully investigated because there is some overlapping of lines. Most lines in spectral regions such as 7930 to 7937 Å (CN red) are closely situated, producing overlap even in a high-dispersion spectrogram. Some water vapor lines overlap with those lines which would otherwise be well suited to the purpose of abundance determination; this effect can be sometimes avoided by the effect of the radial velocity shift of CN lines. Several selected spectral lines are reasonably good for accurate measurement of line intensity in C10 spectrograms with a lower dispersion than those of the echelle arrangement. Coude spectrograms of C4 arrangement, giving a dispersion of 20 Å/mm corresponding to a resolution of about 0.4 Å, were examined. Some lines are still measurable with reasonable accuracy even in these spectrograms. This extends the limit of C stars available for the determination of isotopic abundance. The next step is to develop the survey to faint C stars. (BBB)

52426 OUR UNIVERSE: THE KNOWN AND THE UNKNOWN. Wheeler, John Archibald (Princeton Univ., N. J.). Amer. Sci., 56: 1-20 (Spring 1968).

The straightforward astrophysical evolution of a star that has several times the mass of the Sun and that is already compacted to a density a million times or more greater than the density of the Sun triggers a supernova event. The material of the star collectively moves closer together at an increasing rate. Soon the core outstrips the outer portions of the star in the speed of its collapse. The material of the core, through being suddenly tightly compacted, is heated to an enormous temperature. A core less massive than the critical limit is stopped in its collapse by the onset of nuclear forces. They succeed in offsetting the pull of gravity, when the core has been squeezed to a condition comparable to the atomic nucleus itself in its density. The core then explodes. The very outermost fraction of the exploding envelope is propelled to velocities very little less than the speed of light. The production of the cosmic rays that course about the Galaxy has been proposed to originate in this way. The mechanism gives a reasonable account not only for the observed spectral distribution in energy of the cosmic-ray particles, but also for the order of magnitude of the absolute intensity. In a star where the mass of the core exceeds the critical mass, then the collapse of the core under ever stronger gravitation forces is not halted as nuclear densities are reached. In less than a tenth of a second the collapse is complete. Into this prediction enters not only a principle about the upper limit to the elasticity of matter but also Einstein's theory of how gravitation acts under extreme conditions. This theory of geometrodynamics is discussed. (BBB)

52427 RELATIVISTIC COSMOLOGICAL MODELS. Bomberger, Bill (Notre Dame Univ., Ind.). Notre Dame Sci. Quart., 5: 12-14 (Mar. 1967).

There are only two factors which are well enough accepted to be incorporated in almost all cosmological models: the observational fact of the red shift, and the theoretic concepts of Einstein's field equations and relativistic mechanics. Properties of various models of the Universe are discussed, including first the Einstein static model. Expansion of the Einstein–de Sitter model, cycloidal model, and the hyperbolic model is discussed. The lambda term, did not disappear from use when Einstein rejected it; LeMaitre's model from the solutions of the field equations with the lambda term is graphed. Sir Arthur Eddington's model from solutions of the field equations with the lambda term, identical to Einstein's up to a certain point in time, is noted. Besides all of these models, there are some which not only expand but rotate. In 1949 Gödel constructed a model which does not expand but rotates; it is not consistent with the red-shift data, but it does give rise to the possibility of an expanding, rotating Universe. A model which does not obey the expansion principle is one developed by de Sitter which accounts for the red shift solely as an effect of the geometry of the space–time continuum. In the steady state theory, galaxies eventually recede from us at a speed greater than the speed of light and thus pass from our view; but matter is continuously created in space to form new galaxies. Of the most popular cosmological models, none is universally accepted and few are universally rejected. The reason that so many models can be considered is that there is so little experimental evidence to refute any of the model's predictions. (BBB)

52428 HD 23631: A SHORT-PERIOD BINARY AND EARLY AM STAR. Conti, Peter S. (Univ. of California, Santa Cruz). Astron. J., 73: 348-9 (June 1968).

The star HD 23631, a member of the Pleiades cluster, was found to be an early Am star by a detailed model-atmosphere analysis. A radial velocity study, based on high dispersion spectra, revealed that it is a short-period binary (P = 7.345 days) of small velocity amplitude (14 km/sec). Ten spectra of HD 23631 were obtained at the coude focus of the 120-in. telescope. A list of lines and wavelengths is given which was used for radial velocities. These 10 observations alone, especially the last 5 taken on consecutive nights, indicated unequivocally that HD 23631 is a short-period binary. To find the elements of this binary, a Fortran II computer program was used which employed the Wilsing–Russell harmonic method followed by a least-squares differential correction. Approximate solutions using 3, 4, and 5 coefficients led to nearly identical differentially corrected final elements. Elements of the orbit are given. It is pointed out that for this early Am star, at least, all of the classical Am characteristics are present: anom-

alous abundance, high turbulence, and duplicity. Duplicity will also be so for the other early Am stars, it is suggested. (BBB)

52429 FIVE-COLOR INTERMEDIATE-BAND PHOTOMETRY OF STARS, CLUSTERS, AND GALAXIES. McClure, Robert D.; van den Bergh, Sidney (Univ. of Toronto). Astron. J., 73: 313-37(June 1968).

A total of 210 stars, 70 star clusters, and 56 galaxies was observed on an intermediate-band system that measured the following classification parameters: C(35−38), Balmer discontinuity, C(38−41), line blanketing discontinuity near 4000 Å, C(41−42), strength of the violet CN absorption, and C(42−45), the G-band break. The adopted photometric system supplemented the UBV system and could be used to determine both the spectral types and luminosities of a wide range of reddened stars. Furthermore, the uv excess values for individual reddened main-sequence stars could be determined. The observations were used to measure a metallicity parameter for globular clusters. The highest metallicity was observed in the clusters NGC 5927, NGC 6304, NGC 6352, and NGC 6441. Observations of galaxies of different luminosity showed that cyanogen is weaker in the light of dwarf ellipticals than it is in giant ellipticals, indicating that stars in dwarf ellipticals are surrounded by a halo containing metal-poor stars. Three giant ellipticals appear to consist of a metal-rich core surrounded by a halo containing metal-poor stars. Three giant ellipticals outside clusters are possibly metal poor compared to equally bright elliptical galaxies in clusters. The present 5-color observations were combined with Wood's 12-color photometry to construct population models for NGC 221 (M32), NGC 224 (M31), and NGC 4406 (M86). The results suggested that some of the differences between late M giants in the disk and in the nuclear bulge of the Galaxy might be accounted for by the interstellar gas near the nucleus once containing a very high abundance of He or heavy elements. Color index C(45−48) was shown to be very sensitive to stellar luminosity and almost independent of metal abundance. (BBB)

52430 RADIO EMISSION FROM THE NEBULA SHARPLESS 261 AND THE SURROUNDING GALACTIC REGION. Dickel, John R. (Univ. of Illinois, Urbana). Astron. J., 73: 310-12(June 1968).

During a routine survey of the sky with a 400-ft radio telescope, radio emission was detected from the nebula Sharpless 261. The integrated flux density at 610.5 MHz is 10.6 flux units. This region has the optical appearance of a small bright knot with a larger region of fainter emission extending off to the north. Because the nebula is near the galactic plane, the absorption by intervening dust may obscure the true shape of the emission region. This shape, however, was determined by contour maps of the continuum radio emission. Observations at 610.5, 750, 1410, and 2695 MHz showed that the nebula has 2 components and that the structure is similar to that seen on optical photographs. Both regions of the nebula appear to have thermal radio spectra. The radio observations suggest a model for the nebula with a small condensation near the edge of a large, more tenuous emitting region. The bright southern knot is very evident on the optical photograph but the more extended component appears to be broken up by a lane of absorption which crosses the nebula. This difference between the radio and optical features indicates a nonuniform distribution of absorbing material in the direction of Sharpless 261. If the electron temperature of the nebula is assumed to be ~8000°K and the formula for the Gaunt factor of Oster used, the emission measure for the southern peak is about 3900 cm^{-6} pc, and that for the more extended northern peak is about 1640 cm^{-6} pc. Measurements of the absolute emission from the nebula in various spectral lines are needed in order to determine more of its physical parameters. (BBB)

52431 MEASUREMENTS OF THE FLUX DENSITY OF DISCRETE RADIO SOURCES AT CENTIMETER WAVELENGTHS. I. OBSERVATIONS AT 2695 MHz (11.3 cm). Kellermann, K. I.; Pauliny-Toth, I. I. K.; Tyler, W. C. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J., 73: 298-309(June 1968).

As a part of a program to determine the centimetric spectra of radio galaxies and quasi-stellar sources (QSS), accurate flux densities were determined for a large sample of sources at 2695 MHz (11.3 cm), 5000 MHz (6 cm), and 15,300 MHz (1.96 cm). The total flux density in 2 orthogonal planes of polarization is given for 638 radio sources at 2695 MHz. The relative accuracy for the stronger sources is limited by uncertainties in the variations of the gain of the antenna and radiometer of about 1%, and by confusion for the weaker sources (±0.04 flux units.). (1 flux unit = 10^{-26} W m^{-2} Hz^{-1}.) Radiometer noise was negligible (±0.015 to 0.020 flux units). On overcast days, radiation from atmospheric water-vapor-produced changes in antenna temperature equivalent to a source of up to 0.5 flux units. The absolute scale of flux densities is thought to be accurate to within ±5%. (BBB)

52432 RECEDING OR CIRCULATING QUASARS? Burcev, P. (Brno Univ.). Phys. Lett., 27A: 623-4(Sept. 23, 1968).

A red shift should be seen not only in the expanding metagalaxy but also in a rotating one, where it would be due to the transverse Doppler effect. Calculation shows that the metagalactic rotation could account for the red shift of quasars. (auth)

52433 OBSERVATIONS OF THE RADIO SOURCE W49 WITH THE LARGE PULKOVO RADIO TELESCOPE. Bystrova, N. V.; Gosachinskii, I. V.; Egorova, T. M.; Ryzhkov, N. F.; Frantsesson, A. V. (Central Astronomical Observatory, Pulkovo, USSR. Inst. of Radio Engineering and Electronics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 179-83(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 225-30(Mar.-Apr. 1968).

Observations of the radio source W49 are reported, as made at 21-cm wavelength with the large Pulkovo radio telescope (7′ beam width in the horizontal direction) equipped with a maser. The right ascension, diameter, and flux are determined for each component of the source, and some of their physical properties are evaluated. The absorption of radiation from the source by interstellar neutral hydrogen indicates that both components of W49 are located at a distance of ≈14 kpc from the Sun. (auth)

52434 PHOTOMETRIC OBSERVATIONS OF SOME PECULIAR OBJECTS IN THE WAVELENGTH RANGE 1 TO 2.5 μ. Moroz, V. I.; Dibai, E. A. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 184-8(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 231−6(Mar.-Apr. 1968).

The quasar 3C 273, several galaxies including Seyfert galaxies, and some starlike condensations in the cometary nebula S130 were observed with an infrared photometer (λ_e = 1.6 and 2.1 μ). There is a peculiarity in the spectrum of 3C 273 near 1.6 μ (a "jog"). The Seyfert galaxies NGC 1068 and 1275 exhibit excess infrared radiation at 2.1 μ as compared with normal galaxies. The infrared radiation of the condensations in S130 apparently represents thermal radiation from gas with an emission measure ≈10^8 cm^{-6} pc; the gas density in the condensations is ≈10^5 cm^{-3}. An attempt was made to detect infrared radiation from the neighborhood of W3C, a radio source in the OH lines, but only an upper limit was obtained. (auth)

52435 ABSORPTION OF SOFT X RAYS IN THE INTERSTELLAR MEDIUM AND THE SPECTRUM OF THE SOURCE Sco X-1. Vainshtein, L. A.; Kurt, V. G.; Sheffer, E. K. Sov. Astron. AJ (Engl. Transl.), 12: 189-91(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 237-40(Mar.-Apr. 1968).

Absorption cross sections were computed for H, He, and O in the soft x-ray region. The wavelength dependence of the effective cross section for absorption by the interstellar gas is constructed. The number of H atoms in the direction toward the source Sco X-1 is determined from the profile of the 21-cm line. The x-ray spectrum of Sco X-1 is plotted, taking a distance of 250 pc to the source. (auth)

52436 MASS OUTFLOW FROM STARS INDUCED BY HIGH ATMOSPHERIC OPACITY. Bisnovatyi-Kogan, G. S.; Zel'dovich, Ya. B. Sov. Astron. AJ (Engl. Transl.), 12: 192-8(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 241-50(Mar.-Apr. 1968).

A mechanism is proposed for mass outflow from stars of large mass in advanced evolutionary stages; it entails high atmospheric opacity due to a zone of incomplete hydrogen ionization, and a large heat flow. A model is constructed for an atmosphere subject to outflow with an opacity having a discrete change, approximating the actual relationship. An approximate formula is derived for the mass flow as a function of the luminosity, mass, radius, opacity, and temperature at the point of opacity change, for the case where the stellar radiation much exceeds the energy removed by the mass loss. The possibility of developing a self-consistent stellar model with a static core and an envelope shedding mass is discussed. (auth)

52437 A PRELIMINARY ANALYSIS OF THE PHYSICAL CONDITIONS IN HELIUM-STAR ENVELOPES. Snezhko, L. I. (Univ. of Urals, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 199-201 (Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 251-3(Mar.-Apr. 1968).

The results are reported of calculations for helium-star models having a hydrogen envelope of low mass. It is shown that for $M > 8M_\odot$ radiative equilibrium in the envelope will be unstable and a convection zone will develop. Thermal instability will be possible in the shell source of hydrogen burning for models with $M \leq 2M_\odot$. (auth)

52438 ON THE ORIGIN OF THE BLACKBODY RADIATION OF THE UNIVERSE. Pariiskii, Yu. N. (Main Astronomical Ob-

servatory, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 219-24(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 279-85(Mar.-Apr. 1968).

The possibility is considered that the observed brightness temperature of the Metagalaxy can be interpreted as a consequence of the combined radiation from radio sources with inversion spectra. Red shifts and evolution lead to a sharp increase in the contribution from these sources to the luminosity per unit volume of the Metagalaxy as $Z = \Delta\lambda/\lambda$ increases. The analysis of the data concerning the number of sources, the flux density, and the "geometric" fluctuations in the brightness of the Metagalaxy can be used to obtain rough estimates of the surface brightness (greater than 3×10^9 per sr) and luminosity (10^{42} to 10^{47} ergs sec) of the hypothetical sources of the metagalactic background. (auth)

52439 FLARES, PROMINENCES, AND LOOP PROMINENCES. I. Slonim, Yu. M. (Astronomical Inst., Tashkent). Sov. Astron. AJ (Engl. Transl.), 12: 225-34(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 286-98(Mar.-Apr. 1968).

Powerful flares accompanied by type-IV radio bursts and their relationship to filaments and loop prominences are analyzed. On the basis of data obtained in the radio range and the relationship to filaments the author has determined the spatial localization of flares and the initial altitude of the sources of centimeter, decimeter, and meter radio emission. It is shown that the differences in the physical characteristics and brightness curves of flares are governed by the altitude at which they are generated. (auth)

52440 USE OF A FABRY–PEROT ETALON FOR OBTAINING MONOCHROMATIC SOLAR IMAGES. Kononovich, E. V.; Shcheglov, P. V. (Shternberg State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 235-7(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 299-301(Mar.-Apr. 1968).

The results of an attempt to use a Fabry–Perot etalon for obtaining monochromatic solar images are described. An instrument with an etalon transmitting a band narrower than 0.7 Å with a feeding objective 16 cm in diameter and a 20-cm equivalent focal length made it possible to photograph faint prominences with a $1/_{30}$-sec exposure. (auth)

52441 DENSITIES IN THE EMISSION REGIONS OF IONIZED METALS IN THE LOWER CHROMOSPHERE. I. Shilova, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 238-44 (Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 302-9(Mar.-Apr. 1968).

The intensities of Ti^+, Y^+, Fe^+ emission lines, observed with the IZMIRAN (Institute of Terrestrial Magnetism and Radiowave Propagation) coronograph in the lower chromosphere at heights of 1000 to 2000 km, are examined. The hydrogen concentration in the emission regions of these ions is determined on the assumption that they occupy a considerable portion of the length of the chromosphere along the line of sight $n_H = 1.5 \times 10^{11}$ to 5.0×10^{11} cm^{-3}. (auth)

52442 THEORY OF THE SLOWLY CHANGING COMPONENT OF SOLAR RADIO EMISSION. I. Zlotnik, E. Ya. (Gorky State Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 12: 245-53(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 310-20(Mar.-Apr. 1968).

The results are presented of computations of the principal characteristics of the synchrotron radiation and bremsstrahlung of thermal electrons in an active region on the Sun for which the electron concentration, kinetic temperature, and magnetic field have been determined. The radio brightness over the source at various wavelengths, radio emission spectrum, and dependence of polarization on wavelength are examined in detail. It is shown that neither mechanism separately can explain the full range of experimental data on the slowly changing component of solar radio emission, although individual characteristics of the s-component (frequency spectrum, dependence of polarization on wavelength) fully agree with the concept of a synchrotron generation mechanism; such properties as the radio brightness distribution over a local region and radio emission of the aureole can be understood on the assumption that there is a bremsstrahlung mechanism. (auth)

52443 NEW SOLAR CURVE OF GROWTH. Kuli-Zade, D. M. (Shemakha Astrophysical Observatory, Baku). Sov. Astron. AJ (Engl. Transl.), 12: 254-6(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 321-4(Mar.-Apr. 1968).

With the aid of the most recent data concerning the oscillator strengths of lines, curves of growth for the center of the solar disk were made using lines of Fe I, Ti I, Cr I, V I, Ca I, and Mn I. A solar photospheric model is taken into account. Different physical parameters of the solar photosphere are determined. By combining the individual curves of growth made according to the six chemical elements mentioned above, the most complete mean curve of growth for the center of the solar disk was obtained. (auth)

52444 INFLUENCE OF A HOMOGENEOUS HORIZONTAL MAGNETIC FIELD ON CONVECTION IN A POLYTROPIC ATMOSPHERE. Petrukhin, N. S. (Gorky Polytechnic Inst., USSR). Sov. Astron. AJ (Engl. Transl.), 12: 257-64(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 325-34(Mar.-Apr. 1968).

The convective instability of a polytropic atmosphere subject to a homogeneous horizontal magnetic field is investigated through numerical analysis of equations obtained previously. For the fundamental mode the growth rate and the profiles of the perturbations are determined as functions of the wave number and the magnetic-field strength. The vertical velocity component in the upper part of the atmosphere decreases with increasing magnetic field for perturbations having the same wave number; the size of this decrease is larger for large wave numbers. The presence of a magnetic field sharply alters the profile of the horizontal velocity component. At the upper boundary of the atmosphere the perturbations exhibit a tendency toward an oscillatory behavior. For weak magnetic fields satisfactory agreement is found between the perturbation growth rates obtained in this investigation and previously. The magnetic field may have a substantial influence on the convection in active regions on the Sun. (auth)

52445 THE SUBSYSTEM OF NOVAE IN THE ANDROMEDA NEBULA. Sharov, A. S. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 265-70(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 335-42(Mar.-Apr. 1968).

The apparent and space distribution of novae in the Andromeda Nebula is considered. To a distance of 3 to 4 kpc (15 to 20′) from the center the novae form a spheroidal subsystem with a true axial ratio of about 0.623 or more. The subsystem comprises a nucleus and a corona having different values for the space-density gradient. The density declines more rapidly along the R coordinate than for any spherical subsystem of the Galaxy. The structure of the nova subsystem in our galaxy is discussed. (auth)

52446 THE NATURE OF THE IRREGUALR STRUCTURE OF THE INTERPLANETARY PLASMA. Lotova, N. A.; Rukhadze, A. A. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 271-4(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 343-8(Mar.-Apr. 1968).

One possible mechanism for producing the irregular structure of the interplanetary plasma is discussed; it involves the plasma instability due to the temperature anisotropy in the interplanetary medium. Various types of instability and their spectra are considered as a function of the value of the parameter β applicable to different regions of the interplanetary plasma. It is shown that at large distances from the Sun greater than 1 A.U., the observed irregularities of characteristic size ≈300 to 600 km may be accompanied by smaller irregularities of ≈20 to 100 km. The desirability of attempting to observe these fine-scale irregularities is emphasized. (auth)

52447 THE NATURE OF THE ELONGATED DARK LANES IN DIFFUSE NEBULAE. Dibai, E. A. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 275-8(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 349-52(Mar.-Apr. 1968).

A hypothesis is suggested for the origin of the elongated dark lanes in diffuse nebulae. Local condensations in the nebula (globules) will fall in toward the center of mass of the system comprising stars plus gas under the action of gravitational forces. As it moves a globule will carry along magnetic lines of force, forming an elongated tail. The situation as a whole is described by Rayleigh-Taylor magnetogravitational instability. (auth)

52448 STUDIES OF LOCAL STAR STREAMS. I. THE HYADES STREAM. Ogorodnikov, K. F.; Latyshev, I. N. (Leningrad State Univ.). Sov. Astron. AJ (Engl. Transl.), 12: 279-88 (Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 353-64(Mar.-Apr. 1968).

The stars in the solar neighborhood moving like the Hyades open cluster were investigated. There are several times as many such stars as would be expected from an ellipsoidal velocity distribution. The Hyades cluster may therefore be regarded as extending over a large region of space up to the vicinity of the Sun, with a star density of about 0.004 stars/pc^3. The total number of stars in the Hyades is ≈4000. The Praesepe cluster belongs to the same stream as the Hyades cluster; the total number of stars in the "Hyades stream," is $\approx 10^4$, or perhaps even more. (auth)

52449 INITIAL RESULTS OF A DETERMINATION OF STELLAR PROPER MOTIONS RELATIVE TO GALAXIES. Fatchikhin, N. V. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 289-93(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 365-70(Mar.-Apr. 1968).

Absolute proper motions of 14,000 stars (including 1283 AGK3 stars) relative to 271 galaxies were determined in 82 selected areas of the sky. The probable errors of a single proper motion from a single pair of plates are: for reference stars, ±0".0052; for AGK3 stars, ±0".0070; for galaxies, ±0".0062. The coordinates of the solar apex and the secular parallax, as determined relative to stars of m_{pg} = 14.5 to 15.0, are: $A_\odot$ = 302°.5 ± 4°.5, $D_\odot$ = +32°.6 ± 2°.7, $(\overline{\mu}/\rho)$ = 0".0096 ± 0".0006 (p.e.). A strong dependence of the secular parallax on galactic latitude is found. An analysis was made of the proper-motion differences of 742 AGK3 stars, as obtained and reduced to the FK4 system. Values were computed for the correction to Newcomb's precession constant, Δp_1 = +0".0111 ± 0".0011, $-\Delta E$ = −0".0049 ± 0".0004, and the systematic differences. At the equator the difference $(\Delta\mu_y)_\delta$ reaches the appreciable value of −0".014. (auth)

52450 MEASUREMENTS OF THE PHASE DEPENDENCE OF THE 0.8-cm RADIO EMISSION OF MERCURY, AND SOME PROPERTIES OF ITS SURFACE LAYER. Golovkov, V. K.; Losovskii, B. Ya. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 299-302(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 378-81(Mar.-Apr. 1968).

Observations of the radio emission of Mercury carried out in 1966 with the 22-m radio telescope of the Lebedev Physics Institute yielded the phase dependence of Mercury's brightness temperature; it can be approximated by a function of the form $T_b(\Phi) = (530 \pm 50°) + (290 \pm 70°) \cos(\Phi \pm 15°)$. The accuracy of the absolute measurements is ≈30%. Reductions are also made of Kellermann's measurements at 11.3 cm and Epstein's recent measurements at 3.4-mm wavelength; the radio emission is found to exhibit a phase dependence at these wavelengths. From a comparison of the phase dependences for various wavelengths in the range from 3.4 mm to 11.3 cm a value for the parameter δ/λ characterizing the physical properties of the surface layer was estimated. The value of δ/λ is considerably lower than the corresponding value for the Moon, indicating a possible distinction between the thermal and electrical properties of the surface layers of the two bodies. (auth)

52451 CALCULATION FOR THE OBSERVABLE SURFACE OF A PART OF A FRIEDMANN UNIVERSE. Khrapko, R. I. Sov. Astron. AJ (Engl. Transl.), 12: 334-40(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 419-27(Mar.-Apr. 1968).

The observed appearance of the surface of a part of a Friedmann universe is calculated by analytic continuation of a Schwarzschild coordinate system. For various special cases the dependence of the spectral shift in the light emitted by the surface upon the angle of observation and the total apparent angular diameter of the surface are determined. (auth)

52452 ABSOLUTE DETERMINATION OF STAR DECLINATIONS WITH INSTRUMENTS NOT HAVING ACCURATELY DIVIDED CIRCLES. Kreinin, E. I. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 356-62(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 447-55(Mar.-Apr. 1968).

It is shown that in principle it is possible to make an absolute determination of star declinations with instruments not having accurately divided circles. Three methods are described, corresponding to various combinations of the astrolabe, zenith, telescope, and zenith tube. The results of the declination determinations are found to be independent of the initial star coordinates, the coordinates of the observing station, and the value adopted for the refraction constant. They are also free from systematic errors of circle division and flexure. (auth)

52453 TURBULENT VELOCITIES IN FACULAE AND THE PHOTOSPHERE. Sitnik, G. F.; Mitropol'skaya, O. N. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 363-5(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 456-8(Mar.-Apr. 1968).

Recordings of the infrared oxygen triplet in faculae and the photosphere were obtained with a multialkali photomultiplier attached to the spectrograph of the Kuchino Observatory of the Shternberg Astronomical Institute. The Doppler widths were determined by Goldberg's method. The optical depth of line formation was established from nomograms computed by the method of weighting functions. The turbulent velocities in faculae and the photosphere are derived; the facular velocities exceed the photospheric values. (auth)

52454 LONGITUDE DISTRIBUTION OF SUNSPOTS IN NEW CYCLES DURING THE INITIAL PHASE OF SOLAR ACTIVITY. Berdichevskaya, V. Sov. Astron. AJ (Engl. Transl.), 12: 366-8 (Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 459-61(Mar.-Apr. 1968).

The distribution with respect to heliographic longitude of the earliest high-altitude sunspots ($|\varphi| \geq 20°$) to appear within one year after the beginning of a new solar cycle is considered. The initial periods of eight 11-year cycles (XII-XIX) are investigated from the Greenwich data. It is found that at the beginning of each cycle longitudes exist for which the combined area of the new spots is greatest. In the Sun's northern hemisphere the position of the maximum in the area of new spots shifts regularly after an 11-year cycle to the next quadrant in longitude in the direction of the sun's rotation; after four cycles the distribution of new-spot areas with respect to quadrants repeats itself. The fifth cycle considered (beginning of cycle XVI) represents an exception. For the beginning of cycle XX, different observational material (from "Solnechnye Dannye") has been used so that the data are not compatible in this case. (auth)

52455 VARIATIONS IN THE CIRCUMSTELLAR ENVELOPE OF THE M SUPERGIANT α ORIONIS. Orlov, M. Ya.; Rodriguez, M. H. (Central Astronomical Observatory, Kiev). Sov. Astron. AJ (Engl. Transl.), 12: 369-70(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 462-3(Mar.-Apr. 1968).

Equivalent widths were obtained for the asymmetric part of the Hα line in the spectrum of α Ori (M2 Iab), representing the effect of the circumstellar envelope. Further observations would be desirable to detect any possible variations over a prolonged time interval. (auth)

52456 COLLECTIVE PHENOMENA IN STELLAR SYSTEMS AND THE PROBLEM OF RELAXATION. Marochnik, L. S. Inst. of Astrophysics, Dushanbe, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 371-3(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 464-6(Mar.-Apr. 1968).

The rapid relaxation of stellar peculiar velocities in the Galaxy could result from collective motion of the interstellar gas—gravitational condensation. Collective motion of the stellar "gas" apparently cannot account for the rapid relaxation. (auth)

52457 IMPROVED VALUES OF THE INTERSTELLAR ABSORPTION FOR PLANETARY NEBULAE. Arkhipova, V. P. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 374-5(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 467-9(Mar.-Apr. 1968).

Estimates of interstellar absorption obtained by three independent methods are compared for 26 planetary nebulae. Mean values are derived for the interstellar absorption in the Hβ line. A strong disparity between the absorption estimated from the optical and the radio data is found for large nebulae of low surface brightness; this effect results from a systematic error in the optical measurements. (auth)

52458 EXPLORATION OF THE SUN BY RADIO. Wild, J. P. (CSIRO, Epping, New South Wales). Aust. Phys., 5: 117-22 (Aug. 1968).

A lecture on the radioastronomical study of the Sun is presented. A short historical outline of the subject is given and the solar atmosphere and the various types of outbursts are discussed. (W.D.M.)

52459 THEORETICAL RELATIONS AMONG OBSERVABLE QUANTITIES IN AN ANISOTROPIC AND HOMOGENEOUS UNIVERSE. Tomita, Kenji (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 40: 264-76(Aug. 1968).

The theoretical exact formulas are derived which show the relations among the red shift, the apparent magnitude, and the number of sources with apparent magnitude smaller than a given one for extragalactic objects, in an anisotropic and homogeneous universe. These formulas will be used to measure the degree of anisotropy of the universe, if any, through astronomical observations. (auth)

52460 SOLAR NEUTRINOS AND THE SOLAR HELIUM ABUNDANCE. Iben, Icko Jr. (Massachusetts Inst. of Tech., Cambridge). Contracts GP-8060; NsG-496. Phys. Rev. Lett., 21: 1208-12(Oct. 14, 1968).

The upper limit on the solar neutrino flux set by Davis, Harmer, and Hoffman places an upper limit on the sun's initial helium abundance that is small compared with that estimated for other galactic objects. If current estimates of low-energy nuclear cross-section factors are adopted, the upper limit is essentially equal to a lower bound set by demanding that the sun is at least $4\frac{1}{2} \times 10^9$ yr old. (auth)

52461 POLARIZATION OF THE INTEGRAL RADIO EMISSION OF THE MOON. Alekseev, V. A.; Krotikov, V. D. (Gorky State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1133-7 (1968). (In Russian).

The problem on polarization of the integral radio emission of the Moon is studied theoretically under the assumption that its surface has smooth irregularities with much greater size than a wavelength and with statistics of the incidence angles subjected to

the normal law. The polarization coefficient of the integral radio emission is shown to depend on the phase of the Moon reaching maxima near quadratures. The change of dispersion of the irregularity incidence angles from 0 to 30° leads to decreasing the maximal value of the polarization coefficient in 2.5 to 3 times. In this case the mean-sphere emissivity is decreased by some percents. (auth)

52462 INTERPRETATION OF THE 3°K COSMIC RADIATION OF STAR LIGHT THERMALIZED. Dautcourt, G. Monatsber. Deut. Akad. Wiss. Berlin, 10: 186-95(1968). (In German).

The interpretation of the microwave background radiation in terms of thermalization of star light recently proposed by Hoyle, Narlikar, and Wickramasinghe is discussed. Contrary to Narlikar and Wickramasinghe it is concluded that the steady-state model can hardly account for the results of the direct measurements, which now extend from $\lambda = 73.5$ cm to 0.82 cm, since (i) energy requirements for a mean galaxy are too high and (ii) the spectral distribution of the microwave radiation of a mean galaxy must simulate a Rayleigh–Jeans distribution by itself, which requires impurity oscillators down to frequencies of $(73.5)^{-1}$ cm^{-1}. There are also certain difficulties in evolutionary cosmology. The integrated microwave background emission of all galaxies produces intensities too small by two orders of magnitude, if the oscillation frequencies of interstellar impurity atoms are in the range of 10 cm^{-1}. Evolutionary cosmology also gives a slope smaller than the observed one (depending on the cosmological model), thus yielding a flux too large at lower frequencies, provided the emission rate per galaxy has remained constant since a time corresponding to a redshift as large as $z \approx 734$. Strong evolution effects must be expected at this time however. By choosing a time dependence of the emission rate properly ($\sim t^b$ in an Einstein–De Sitter model) the observed spectrum could principally be obtained. Since sound predictions of the emission rate by following the evolution of a galaxy or pregalaxy are presently not available no obvious contradiction of the proposed mechanism if acting in a relativistic world model can be found, although the observations require stringent conditions e.g., the oscillator frequencies. (auth)

52463 MATTER PRODUCTION AND 3°K RADIATION. Kaper, U. Monatsber. Deut. Akad. Wiss. Berlin, 10: 195-200(1968). (In German).

The constant weak character of the background radiation permits the thesis on the production and annihilation of matter to be made more precise. At best, particles with rest mass different from zero can be produced and annihilated. In the Hoyle theory, the background radiation is considered as a free radiation field. When this radiation field is not constantly weak, then in the past there was a state of higher radiation density in which the interaction with the residual matter can not be neglected. The residual matter plays the role of the Planck coal dust and makes the radiation weak. Therefore if no cosmological singularity occurs, the maximum radiation density was at least equal within an order of magnitude to the Hoyle f. (tr-auth)

52464 RELATION BETWEEN OPTICAL AND RADIO PHENOMENA OF THE SUN FROM INVESTIGATIONS OF THE SOLAR ACTIVITY MINIMUM. Kleczek, J.; Olmr, J.; Krueger, A. Monatsber. Deut. Akad. Wiss. Berlin, 10M: 229-32(1968). (In German).

An inventory was made of 772 days in 1961–67 for which there was either no or only one sunspot group visible. The sunspot groups were arranged according to Brunner type and compared with the emission of the s component on those days. The mean radiation current of the s component was obtained at individual observation frequencies as a function of the type of sunspot. The mean number of cm bursts and type-III bursts was also determined in dependence on the sunspot type. Data were thus obtained on the mean time profile and development of the s component, which were comprehensible for the first time in concrete form by the statistical method. (J.S.R.)

52465 OPTICAL IDENTIFICATIONS OF OHIO RADIO SOURCES WITH PECULIAR SPECTRA. Thompson, J. R. (Ohio State Univ., Columbus); Kraus, J. D.; Andrew, B. H. Astrophys. J., 154: L1-3(Oct. 1968).

Optical identifications were sought for seventeen Ohio-survey sources with peaked or flat spectra. Six suggested identifications are made with single stellar objects, two of which are blue; four with red and blue pairs of stellar objects; and three with galaxies (two with unusual characteristics). There are two confused fields and two empty fields. (auth)

52466 CONCERNING REDSHIFTS IN THE SPECTRA OF QUASI-STELLAR OBJECTS. Cowan, Clyde L. (Catholic Univ. of America, Washington, D. C.). Astrophys. J., 154: L5-9(Oct. 1968).

A pattern appears to be discernible in the list of red shifts reported to date for the emission-line spectra of quasi-stellar objects. The pattern is consistent with the presence of fractional screening charges ($\simeq e/12$) on the nuclei of the emitting atoms. (auth)

52467 LOCAL SPIRAL-ARM MAGNETIC FIELD. Mathewson, D. S.; Nicholls, D. C. (Australian National Univ., Canberra). Astrophys. J., 154: L11-16(Oct. 1968).

On the basis of polarization measurements of stars mostly within 500 pc of the Sun, Mathewson put forward evidence for a helical component of the local magnetic field. This helical magnetic field is found to explain most of the large-scale features of observations of galactic radio polarization. The distribution of sense of the rotation measures of extragalactic radio sources is explained if a longitudinal magnetic field directed toward $l^{II} = 90°$ is added to the helical field. The helical field is thought to be associated with a nearby condensation. The longitudinal field is probably the general disk magnetic field. (auth)

52468 SEARCH FOR OH EMISSION FROM INFRARED OBJECTS. Eliasson, Baldur; Groth, Edward J. (California Inst. of Tech., Pasadena). Astrophys. J., 154: L17-19(Oct. 1968).

This note reports an unsuccessful search for OH emission from nine infrared sources at 1665.401 MHz. The search was made with the two-element interferometer at Owens Valley. (W.D.M.)

52469 TIME-DELAY EFFECTS IN THE SPECTRA OF JUPITER'S DECAMETRIC RADIATION OVER A 70-km BASE LINE. Riihimaa, J. J. (Univ. of Colorado, Boulder). Astrophys. J., 154: L25(Oct. 1968).

Spectral details of Jupiter's decametric emission recorded at spaced sites show a time shift indicating a westward motion of a shadow pattern across the ground. The inferred velocities, 250 to 350 km sec^{-1}, are consistent with the projected solar-wind velocity. (auth)

52470 ON THE OPTICAL IDENTIFICATION OF THE X-RAY SOURCE CEN XR-2 AS WX CEN. Eggen, O. J.; Freeman, Kenneth C.; Sandage, Allan (Australian National Univ., Canberra). Astrophys. J., 154: L27-31(Oct. 1968).

The variable star WX Cen ($\alpha[1950] = 13^h09^m38^s$, $\delta[1950] = -63°08'$) is within the error radius of the best-determined x-ray position of Cen XR-2. Optical observations show that the star has the peculiar colors $\langle B-V\rangle \simeq +0.45$, $\langle U-B\rangle \simeq -0.72$, similar to those of Sco X-1; it varies from night to night with an observed range $\Delta V \simeq 0.4$ mag; and has a rare optical emission-line spectrum which resembles Sco X-1. (auth)

52471 PHOTOGRAPHIC OBSERVATIONS OF WX CEN. Lynga, Goesta (Uppsala Southern Station, Canberra, Australia). Astrophys. J., 154: L33(Oct. 1968).

The star WX Cen, suggested in the preceding letter as an optical identification of Cen XR-2, was observed on three double-image (U,B) plates taken with the Uppsala Schmidt telescope on May 15, 1967, May 17, 1967, and March 30, 1968. (W.D.M.)

52472 REPORTS OF THE SHEMAKHINSKAYA ASTROPHYSICAL OBSERVATORY. VOLUME IV. SOLAR PHYSICS. Sultanov, G. F.; Aslanov, I. A.; Eminzade, T. A. (eds.). Soobshch. Shemakhinskio Astrofiz. Observ., Akad. Nauk Azerb. SSR, 4: 1-71(1965). (In Russian).

Five articles are included on solar physics. The behavior of the forbidden oxygen line λ6300A and the helium line D_3 in the semi-shadow of the large spots are discussed in the first two articles. The chromospheric bursts and the problem of strong-point explosions considering the heat exchange in self-similar motion and spherical symmetry are covered in the third article. The fourth and fifth chapters cover the computation of optical depth of Ti I lines in the solar spectrum and correlations of scintillations of binary star images. (R.V.J.)

52473 CHEMICAL PROCESSES IN THE EARLY SOLAR SYSTEM, AS INFERRED FROM METEORITES. Anders, Edward (Univ. of Chicago). Accounts Chem. Res., 1: 289-98(Oct. 1968).

An analysis is presented that if valid means that the chemical composition of the chondrites was established in the solar nebula and has changed but little in subsequent eons. The meteorites falling on the Earth represent a fairly wide range of environments, from high to low temperatures and strongly reducing to oxidizing conditions. Topics considered include the classification of meteorites, chemical composition of chondrites, abundance patterns, fractionation mechanisms, condensation sequence of the elements, interpretation of abundance patterns, origin of the high-temperature fraction, other models, the Earth, inner planets, organic compounds, and some remaining problems. (W.D.M.)

Atomic and Molecular Physics

Refer also to abstracts 53033 and 53226.

52474 (CLM-Trans-13) BORN APPROXIMATION EXCITATION CROSS SECTIONS FOR ATOMS BY ELECTRONS. Vainshtain, L. A.; Sobelman, I. I. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Culham Lab., Abingdon, Eng., from Lebedev Report No. 66. 43p. Dep. CFSTI. UK 8s. 0d.

Expressions and parameter tables from which effective cross sections and coefficients $\langle v\sigma \rangle$ for excitation of atoms by electrons in the Born approximation can be calculated are presented. (TSS)

52475 (INR-P-924) Z-DEPENDENCE OF THE STOPPING POWER AT LOW ENERGIES. Turos, Andrzej (Institute of Nuclear Research, Warsaw (Poland)). 1968. 6p. Dep.

A relation between the stopping power of a medium and its atomic number is established, which permits calculation of energy losses in substances for which no data are available. Results of calculations for H and He ions of energies from 0.5 to 8 MeV/amu are tabulated. (A.G.W.)

52476 (LA-3949) MAJORANA DEPOLARIZATION OF HYDROGEN, DEUTERIUM, OR TRITIUM ATOMS. Ohlsen, Gerald G. (Los Alamos Scientific Lab., N. Mex.). May 1968. Contract W-7405-eng-36. 30p. Dep. CFSTI.

The theory required to follow the behavior of a hydrogen, deuterium, or tritium atom in a time-dependent magnetic field is described. A computer code is included, and some numerical results of interest to the design of Lamb-shift polarized-ion sources are presented. A brief discussion of depolarization effects in pick-up or stripping of two electrons is also presented. (auth)

52477 (LA-4006) RADIATIVE TRANSFER WITH SCATTERING. Pomraning, G. C. (Los Alamos Scientific Lab., N. Mex.). Sept. 1, 1968. Contract W-7405-eng-36. 13p. Dep. CFSTI.

The equation of radiative transfer including the effects of photon scattering is discussed. The case of scattering from a Maxwellian gas of free electrons is considered in detail. The mathematical description of this process in the equation of transfer is formulated in two different ways, one differential and the other integral in character. Both descriptions have the potential of being incorporated into a general-purpose radiative transfer code. (auth)

52478 (NLCO-1014) MODIFICATION OF A COMPUTER PROGRAM FOR CONVERTING ELECTRON MICROPROBE DATA TO TRUE CHEMICAL COMPOSITION. Wise, W. N. (National Lead Co. of Ohio, Cincinnati). Oct. 1968. Contract AT(30-1)-1156. 42p. Dep. CFSTI.

A program for the correction of microprobe data was modified for a computer-compiler with a maximum memory capacity of 32,000 characters by using two magnetic tape drives and chaining the program sections. The program, written in Fortran IV, stores all the parameters necessary for correcting x-ray intensity data. The only input data required are the chemical symbols of the elements in the system, the x-ray lines analyzed, the accelerating potentials, and the x-ray intensities. (auth)

52479 (NP-17636) SURFACE AND VACUUM PHYSICS INDEX. Bibliography; Author Index; Subject Index; List of Keywords. Volume 3, No. 7 (854-1011). Hilsenbeck, D. (ed.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 55p. Dep.

157 articles on various aspects of surface and vacuum physics are listed. Subject and author indexes are included. (M.O.W.)

52480 (RRL-2310-224) STUDY OF ELECTRON DECAY IN PULSE-IRRADIATED GASES BY A MICROWAVE TECHNIQUE. Fessenden, Richard W.; Warman, John M. (Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.). Jan. 5, 1968. Contract AT(30-1)-2310. 19p. (CONF-680806-3). Dep. CFSTI.

From Conference on Radiation Chemistry, Argonne, Ill.

A microwave technique for measuring the decay of electrons in pulse-irradiated gases is described. The technique involves the measurement of the change in resonant frequency of a microwave cavity due to a change in the complex conductivity within the cavity when electrons are present. Single pulses of 3-MeV electrons from a Van de Graaff accelerator are used to ionize the gas. Electron densities as low as 10^7 cm^{-3} (total dose ~0.3 RAD at 10 torr) can be measured accurately. In the absence of diffusion the method can be used to study electron loss by electron capture or electron–ion recombination for pressures as low as 1 torr and as high as at least 200 torr. The potential of the technique is illustrated by results obtained with pulse-irradiated air. The effective two-body rate constant for electron capture by oxygen in air is found. (auth)

52481 (UCRL-18387) EXPERIMENTAL STUDIES ON THE METASTABLE LIFETIMES IN HELIUM AND NEON. Steinberg, Murray (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1, 1968. Contract W-7405-eng-48. 90p. Dep. CFSTI. Thesis.

A time-of-flight method for measuring the mean life of long-lived atomic states is described. The results of applying the method to the (1s2s) $^1S_0$ state in helium results in a measurement of a pressure-limited lifetime that leads to the conclusion that the lifetime must be greater than 9 msec. A tentative conclusion resulting from an application of the method to neon is that the $1s^2\ 2s^2\ 2p^5\ (^2P^0_{\frac{3}{2}})3s$ J = 2 state has a lifetime greater than 5 msec, while the $1s^2\ 2s^2\ 2p^5\ (^2P^0_{\frac{3}{2}})3s$ J = 0 state has a lifetime greater than 33 msec. (auth)

52482 CROSS SECTIONS FOR ELECTRON CAPTURE BY PROTONS. Mapleton, R. A. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Phys., B (London), 1: 850-5(Sept. 1968).

Average values of differential cross sections for electron capture by protons, as calculated using the wave version of the first Born approximation, are defined for neutral atomic targets that are randomly oriented with respect to the direction of incidence. Only for transitions between S states of the atomic target and the residual ion are the constituent cross sections independent of the orientation of the atomic frame of reference. The averaging procedure, used to remove the dependence upon the relative orientation between the atomic frame of reference and the direction of incidence, is exemplified by a calculation of the averages for transitions from S states to P states, and P states to P states. (auth) (UK)

52483 MEASUREMENTS OF CROSS SECTIONS FOR THE IONIZATION OF Li^+ AND Ba^+ IONS BY ELECTRON IMPACT. Peart, B.; Dolder, K. T. (Univ. of Newcastle, upon Tyne, Eng.). J. Phys., B (London), 1: 872-8(Sept. 1968).

Cross sections were measured for the reaction $Li^+ + e \rightarrow Li^{2+} + 2e$ for electron energies between threshold and 3 keV. The cross section reaches a maximum value of 4.15×10^{-18} cm^2 ±6% at an electron energy of 325 eV. At higher energies the results are similar to those of Rapp and Englander-Golden (1965) for helium when the latter measurements are scaled classically. The reaction $Ba^+ + e \rightarrow Ba^{2+} + 2e$ was investigated for electron energies between threshold and 2 keV. At an electron energy of 18 eV the cross section increases abruptly from 1.6×10^{-16} cm^2 to 4.25×10^{-16} cm^2. This is interpreted as the onset of autoionization (inner-shell excitation). (auth) (UK)

52484 SINGLE-ELECTRON CAPTURE BY SLOW PROTONS IN HELIUM. Colegrave, R. K.; Stephens, D. B. L. (Chelsea Coll. of Science and Tech., London). J. Phys., B (London), 1: 856-62(Sept. 1968).

The perturbed stationary state method is applied to $He(1s^2) + H^+ \rightarrow He^+(1s) + H(1s)$ but with neglect of momentum transfer. The calculations of Green et al., (1965) and of Sin Fai Lam (1967) show that the approximation is untenable at energies above 16 keV. The experimental results of Hasted and Stedeford (1955) and of Stier and Barnett (1956) for the sum total of all processes involving charge transfer from helium to protons are exceeded from 3 to 10 keV. The differential cross section at small angles or deflection compares reasonably well with the experiments of Helbig and Everhart (1964) for energies below 5 keV. (auth) (UK)

52485 FORMATION AND DESTRUCTION OF FAST METASTABLE HELIUM ATOMS IN CHARGE-CHANGING COLLISIONS. Gilbody, H. B.; Browning, R.; Levy, G.; McIntosh, A. I.; Dunn, K. F. (Queen's Univ. of Belfast). J. Phys., B (London), 1: 863-71(Sept. 1968).

Collisions involving one-electron capture and loss during the passage of 60 to 450 keV helium beams through hydrogen were investigated by a technique which allows the fast metastable atom population of the beam to be determined. One-electron loss cross-sections σ_{0*1} and σ_{01} for metastable and ground-state helium atoms were separately determined. σ_{0*1} was found to be between 13 and 3 times greater than σ_{01} in the energy range reviewed. It is shown that at energies between 80 and 250 keV, where the formation of He^{2+} is relatively unlikely, a satisfactory description of the charge equilibration of fast helium beams can be obtained in terms of charge-changing collisions involving He^+ ions and ground-state and metastable helium atoms. Cross sections σ_{10} and σ_{10*} for one-electron capture into metastable and ground states of helium were estimated in the range 75 to 250 keV, where it is found that σ_{10*} is between 30% and 50% σ_{10}. (auth)

52486 PROPERTIES OF AUTOIONIZING STATES OF He. Macek, J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., B (London), 1: 831-43(Sept. 1968).

The properties of Rydberg series of autoionizing levels of He converging to the n = 2 level of He^+ are discussed on the basis of the assumption that the Schrödinger equation is approximately separable in the coordinates $R = (r_1^2 + r_2^2)^{1/2}$ and $\alpha = \tan^{-1} r_2/r_1$. For each Rydberg series a "potential" in R is obtained, and the properties of the autoionizing states follow from the shape of the "potentials." Energies of some of the states are calculated and compared with energies from experiment and more conventional calculations. (auth) (UK)

52487 OCTUPOLE TRANSITIONS IN EXCITATION BY ELECTRON IMPACT. Garstang, R. H. (Univ. of Colorado, Boulder). J. Phys., B (London), 1: 847-9(Sept. 1968).

The contribution of direct electric octupole excitation to the generalized oscillator strength for electron impact was calculated, and numerical results obtained for the $4\,^2S-4\,^2F$ transition in potassium. The contribution is insufficient to account for the observed cross section for this transition. (auth) (UK)

52488 ANGULAR DISTRIBUTIONS FOR RESONANT SCATTERING OF ELECTRONS BY MOLECULES. Read, F. H. (Univ. of Manchester, Eng.). J. Phys., B (London), 1: 893-8 (Sept. 1968).

A general expression was obtained for the angular distributions of electrons scattered resonantly by molecules. Specific expressions are given for particular types of molecules, and angular distribution coefficients are tabulated for these types. (auth) (UK)

52489 INTERACTION OF FAST ELECTRONS WITH MATTER: EFFECTIVE DENSITY. Loevinger, Robert. pp 16-20 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

The basic modes of the interaction of fast electrons with matter are reviewed. Physical aspects of inelastic collisions, radiative collisions, elastic scatter, and secondary electron production are discussed. (W.H.K.)

52490 STUDIES OF ABSORPTION OF HIGH ENERGY ELECTRON BEAMS. Laughlin, John S. pp 11-16 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965.

See CONF-640918.

Fundamental theoretical and experimental studies on the absorption of electrons in matter are summarized. Calculated energy absorption and charge distribution curves for electron beams in water are presented, and the measured distribution of charge as a function of depth in conducting polystyrene produced by 20-MeV electrons is shown graphically. (W.H.K.)

52491 DISTRIBUTION OF δ-ELECTRONS IN A BODY IRRADIATED WITH HIGH ENERGY ELECTRONS. Wideroee, Rolf. pp 33-6 of Symposium on High-Energy Electrons. Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York Springer-Verlag, 1965.

See CONF-640918.

Calculation of the number of first generation delta-electrons produced in water with energies above 750 eV in relation to the ionization stopping power for primary electrons with energies from 4 keV to 30 MeV is discussed. (W.H.K.)

52492 ENERGY SPECTRA OF FAST ELECTRONS AT DIFFERENT DEPTHS. Harder, Dietrich. pp 26-33 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7-11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. (In German).

See CONF-640918.

To determine the energy spectra of fast electrons at different depths, measurements by means of a scintillation-spectrometer and also Monte Carlo calculations were carried out. They are in good agreement, and the Monte Carlo procedure appears suitable in cases of practical interest. From the experiments a simple and sufficiently accurate rule can be derived for the decrease of the average electron energy in relationship to depth. (auth)

52493 ADIABATIC APPROXIMATION AND NECESSARY CONDITIONS FOR THE EXISTENCE OF BOUND STATES. Gertler, F. H.; Snodgrass, H. B.; Spruch, Larry (New York Univ., N. Y.). Phys. Rev., 172: 110-18(Aug. 5, 1968).

Let $H(\vec{\rho},\vec{r})$ represent the (M − 1)-body Hamiltonian that results from fixing the center of mass $\vec{R}$ of an M-body system, where $\vec{r}$ is the relative coordinate of a particular pair of particles, and $\vec{\rho}$ represents the M − 2 remaining internal coordinates. With E_{thr} the lowest continuum threshold associated with H, the number of bound states of the system is the number of negative eigenvalues of $H - E_{thr}$. A simple lower bound on H was derived by Hahn and Spruch through the use of an adiabatic-like approximation in which the (M − 1)-body problem is attacked by considering first an (M − 2)-body problem and then a one-body problem. With $E_{a0}(r)$ the lowest energy of the system for $\vec{R}$ and $\vec{r}$ fixed, one finds $H(\vec{\rho},\vec{r}) - E_{thr} \geq \hat{1}(\vec{\rho})H^{(1)}(\vec{r})$, where $H^{(1)} \equiv T_{\vec{r}} + E_{a0}(r) - E_{thr} \equiv T_{\vec{r}} + V^{(1)}(r)$. $H^{(1)}$ is a one-body Hamiltonian, $T_{\vec{r}}$ is the kinetic energy operator for the relative motion of the particular pair, and $\hat{1}(\vec{\rho})$ is the unit operator in the space of quadratically integrable functions of $\vec{\rho}$. The adiabatic potential $E_{a0}(r)$ was tabulated for a number of systems, primarily atomic and molecular. A necessary condition for the existence of a bound state of H is that the lowest eigenvalue of $H^{(1)}$ be negative. The method is formulated for the case of Coulomb interactions. It is shown that neither $He + e^+$ nor $\alpha + p + e^-$ can form bound states. Lower bounds of −0.068 and −0.065 eV are found on the energy of the ground state and the first excited state, respectively, of the $H + e^+$ system; presumably there is no bound state of this system, but it is not certain. The system $H + e^-$ is also considered. (auth)

52494 ENERGY DISTRIBUTION FUNCTION FOR HELIUM. Elkomoss, S. G. (McDonnell Douglas Corp., St. Louis). Phys. Rev., 172: 153-62(Aug. 5, 1968).

The energy distribution functions, electron mean energies, drift velocities, and electron temperatures are calculated for several values of E/P: 0.1, 0.2, 0.3, ... 1 and 2, 3, 4, ... 10, where the strength E of the applied electric field is given in V/cm and the pressure P of the gas in torr. The effects of elastic scattering only are considered. The calculations are carried out for helium using the available data for the momentum-transfer cross sections $Q_D(\epsilon)$, where ϵ is the electron energy in eV. The results are strongly dependent on these data. The assumption that Q_D is constant for intermediate values of $\epsilon > 19.2$ eV, proposed by Barbière, is apparently in serious error, particularly for E/P > 3 V/cm torr. Using the phase-shift data of McDougall, Allis and Morse, and of LaBahn and Callaway, the values of $Q_D(\epsilon)$ at intermediate and high electron energies vary as $1/\epsilon^n$, where n lies between 3/4 and 7/8. In this case the distribution functions converge slowly, and the calculated drift velocities are much higher than those obtained from experiment. With $Q_D \propto 1/\epsilon^{1/2}$ for $\epsilon > 40$ eV, the recent data of Frost and Phelps for the momentum-transfer cross sections give the best agreement with experiment. The calculated drift velocities are lower than those measured. By assuming $Q_D \propto 1/\epsilon^{1/2}$ for $\epsilon > 19.2$ eV and considering the experimental data of Ramsauer and Kollath for the differential scattering cross sections and the data given recently by Golden and Bandel for the total scattering cross sections, good agreement is found for the calculated drift velocities. In this case, the calculated values are higher than those observed. The experimental data of Crompton and Jory for the momentum-transfer cross sections do not offer satisfactory values for the drift velocities; the higher the values of E/P, the less the agreement between calculations and the experimental results. (auth)

52495 TWO-PHOTON ANNIHILATION OF AN ELECTRON–POSITRON PAIR IN AN EXTERNAL MAGNETIC FIELD. Ternov, I. M.; Lysov, B. A.; Dorofeev, O. F.; Pavlova, O. S. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 31-6 (1968). (In Russian).

The influence of a magnetic field on annihilation of an electron–positron pair in the case of free particle motion in strong magnetic fields was studied. Calculations according to the intermediate states proved to be very complex. In order to simplify the problem it was assumed that the electron and positron are moving towards each other along the magnetic field. Such assumption limited the problem and permitted comparison of the annihilation process with the annihilation during free motion. It was found that, in case of high magnetic field intensity, the cross section of ultrarelativistic motion decreased sharply in comparison with nonrelativistic electron and positron velocities (or free particle motion). (R.V.J.)

52496 ABSOLUTE MEASUREMENTS OF THE IONIZATION COEFFICIENTS OF ALKALI ATOMS ON METAL SURFACES. III. RUBIDIUM ATOMS ON TUNGSTEN AND PLATINIUM SURFACES. Hillecke, D. (Technisc]he Univ., Clausthal, Ger.). Z. Phys., 215: 343-9(1968). (In German).

Continuing the systematic measurements of the positive surface ionization of alkali metals on incandescent clean polycrystalline surfaces the present absolute determination of the ionization coefficient β of rubidium on platinum surfaces gives a value of 1.00 between 1200 and 1700°K. A maximum ionization coefficient of $\beta = 0.95$ was observed for the system Rb/W at a temperature of about 1150°K. The ionization at higher temperatures and therefore the dependence on temperature are in agreement with the Saha–Langmuir equation. (auth)

52497 MULTIPHOTON IONIZATION OF ATOMIC HYDROGEN IN THE GROUND STATE. Gontier, M.; Toshin, M. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev., 172: 83-7(Aug. 5, 1968).

The general theory of multiphoton ionization of hydrogen atoms by simultaneous absorption of several photons is discussed. In the nonrelativistic dipole approximation, the calculations lead to a recursion relationship concerning angular functions and involve radial matrix elements containing many summations over intermediate states. A general method for exactly evaluating several sums is described in detail and applied to the photo-ionization of atomic hydrogen in the ground state. Numerical results are presented for dispersion curves of the transition rate σ_n/I^{N-1} for a range of wavelengths from 1000 to 7200 Å. (auth)

52498 REPRESENTATION OF ELECTRON SCATTERING IN PHOTOELECTRIC ANGULAR DISTRIBUTIONS. Hultberg, S.; Erman, Peter (Research Inst. of Physics, Stockholm). Ark. Fys., 37: 151-201(1968).

The modification of photoelectric angular functions due to photoelectron scattering was studied, using both experimental and computational techniques. It is shown that available theories of multiple scattering can be used in spite of the many limitations on their application. This is probably due to smoothing-out effects in integrals performed over the angular functions. Using $d/d_0 = 0.5$ in the calculations, where d_0 is the converter thickness, it was found to give good reproduction of experimentally measured photoelectric differential cross sections. Several applications to the determination of internal conversion coefficients indicate that the scattering correction introduced works satisfactorily. (Sweden)

52499 INFLUENCE OF SURFACES ON THE ENERGY LOSSES OF FAST ELECTRONS TRAVERSING THIN Al-FILMS. Imbusch, A. (Technische Univ., Berlin). Z. Phys., 216: 94-102(1968). (In German).

The characteristic energy losses of electrons traversing thin Al films were measured with high resolution. Especially their dependence on film thickness was investigated. To interpret satisfactorily the observed dispersion of surface plasma loss, retardation effects had to be taken into account. Furthermore, energy losses in the low-energy part of the spectrum, e.g., the intraband energy loss of Al, are shown to be surface losses in terms of the dielectric theory. (auth)

52500 PROTON SPUTTERING OF POLYCRYSTALLINE GOLD. Finfgeld, Charles Ryno. Blacksburg, Va., Virginia Polytechnic Inst., 1968. 66p.

Thesis.

An experiment to determine the yield and angular distribution for sputtering of polycrystalline gold by normally incident protons of energies between 500 eV and 8 keV has been performed. An ion source system delivering a magnetically analyzed proton beam of 1 ma/cm^2 current density to a target at a pressure of 5×10^{-6} torr was utilized. Measurement of the integrated proton current, with correction for secondary electron emission, and determination of the quantities of sputtered gold by neutron activation, established the yields. Autoradiographs of the sputtered deposits were used to study the angular distribution. The gold targets, consisting of microcrystals with preferred orientation, were sputtered predominantly on (100) and (110) planes, and the yields were not observed to depend perceptibly on the crystal orientation. The yield was a maximum of 0.014 atoms/proton at a proton energy of 4 to 5 keV, dropping off gradually at higher energies and sharply at lower ones. Analysis of the sputtered deposit spot patterns indicated that focused collision sequences were of greater importance in proton sputtering than in sputtering by heavier ions. Significantly, a readily detectable yield for sputtering by 500-eV protons, which could transfer at most 10 eV to gold atoms in the target, suggests a new, lower sputtering threshold for gold. (auth) (Diss. Abstr.)

52501 DIFFUSION AND TRANSFER OF EXCITATION IN COLLISIONS BETWEEN METASTABLE ^{3}He ATOMS. Pakhomov, P. L.; Fugol, I. Ya. (Physico-Technical Inst. of Low Temperatures, Kiev). Dokl. Akad. Nauk SSSR, 179: 813-16(Apr. 1, 1968). (In Russian).

An attempt was made to reconstruct the shape of potential energy curves in such a manner that they would more closely fit the theoretical and experimental data. The constructed empirical potentials are used for calculations of total cross section Q, diffusion cross section Q_d, and excitation transfer cross section Q_{tr}. Calculated magnitudes Q_d are compared with the experimental data obtained by the authors for the diffusion coefficient of helium-3 metastable atoms in the temperature range from 300 to 4°K. Calculations of Q_{tr} were correlated with experimental data obtained by F. D. Colegrove et al. (Phys. Rev., 135: 352 (1964)) for the temperature range from 500 to 4°K. (R.V.J.)

52502 π-MESONIC ATOMS. Daniel, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg. CERN, Geneva). Naturwissenschaften, 55: 314-24(July 1968). (In German).

A brief review is given of the known properties of mesic atoms, and their origin is discussed. The experimental arrangement at CERN for the study of mesic atoms is described and some typical muonic and pionic x-ray spectra obtained are reported. The theory of μ- and π-mesic atoms is given. The muonic and pionic transitions measured at CERN are tabulated and the results are compared with those obtained elsewhere. The CERN results on the measurement of the effect of the condensed state in muonic x-ray lines are tabulated. (J.S.R.)

52503 PLASMA ELECTRON SOURCE FROM A HOLLOW CATHODE. Dubinina, E. M.; Ibadov, S. (Moscow Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1262-8(1968). (In Russian).

A gas discharge in a compact hollow cathode is used in order to obtain an intense, well-focused, electron beam having a high compression ($\sim 10^4$). Since the gas required for the discharge is fed directly to the cathode region which has a very small outlet opening, the gas consumption is small, and the unit can be maintained readily at a vacuum of 1 torr for air or 10 torr for helium. By using such properties of a dense low-temperature plasma as high polarizability and electric conductivity in combination with a hollow cathode and a system of setting off the discharge, it was possible to obtain a concentrated electron beam. The cathode requires no preliminary treatment, and operates in a stable manner in a complex gas atmosphere. Preheating is not required with the cathode establishing a temperature of 500°C under moderate operating conditions. The occurrence of a large threshold discharge current is explained. A mechanism for the formation of a crossover of the electron current at the cathode exit is given, and equations for calculating plasma density in the cathode hollow are derived. (TTT)

52504 EFFECT OF GEOMETRIC PARAMETERS OF A TRIODE ELECTRON GUN ON THE MAGNITUDE OF THE CUTOFF POTENTIAL. Kabanov, A. N.; Kafarov, A. A.; Starostin, E. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1192-4(1968). (In Russian).

The geometric parameters having the greatest effect on the characteristics of an electron beam are the immersion depth h of the tungsten cathode needle into the opening of the control electrode with diameter d, the depth of the channel opening δ, the distance l between the cathode and anode, and the configuration of the control electron. The cutoff potential U_c is the potential on the control electrode, which is negative with respect to the cathode, at which the emission current becomes equal to zero. The cutoff potential was determined after 10 minutes heating up of the cathode. At accelerating potentials of 50, 75 and 100 kV it was found that the cutoff potential U_c as a function of immersion depth could be expressed by a relation of the form: $U_c = A \exp(bh)$. Here A is the cutoff potential at h = 0, and b is a coefficient which takes into account the geometric parameters. The coefficient b is constant for a given configuration of the control electrode at given values of d, δ and l. Finally the cutoff potential as a function of the primary geometrical parameters and the accelerating potential U can be presented in the form: $U_c = kUd \exp(bh + c/l)$. Here k, b and c are constants that are determined by varying one of the geometrical parameters at any time. (TTT)

52505 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF METASTABLE HELIUM FROM HELIUM AND ARGON. Grosser, J.; Haberland, H. (Univ., Freiburg i. B.). Phys. Lett., 27A: 634-5(Sept. 23, 1968).

Measurements of the differential scattering cross section of metastable 2S He from ground state He and from Ar are reported. They permit some conclusions on the position and depth of the outermost minima of the potential curves. (auth)

52506 ATOMIC BEAM STUDY OF THE ^{85,87}Rb RELATIVE ISOTOPE SHIFT. Duong, T. H.; Marrus, R.; Yellin, J. (Univ. of California, Berkeley). Phys. Lett., 27B: 565-6(Sept. 30, 1968).

The ^{85,87}Rb relative isotope shift has been investigated by an atomic-beam technique and found to be 0.35 ± 0.05 m^{-1}. The ^{87}Rb $5^2P_{\frac{1}{2}}$ hyperfine structure has also been determined and agrees with previous measurements. (auth)

52507 CONDENSED-STATE EFFECTS IN PIONIC AND MUONIC X-RAY SPECTRA. Tauscher, L. (CERN, Geneva. Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Karlsruhe, Ger.); Backenstoss, G.; Charalambus, S.; Daniel, H.; Koch, H.; Poelz, G.; Schmitt, H. Phys. Lett., 27A: 581-2(Sept. 23, 1968).

Intensity measurements of pionic and muonic x rays in targets of different physical or chemical composition are reported. (auth)

52508 ELECTRON LOSS OF IODINE IONS BETWEEN 13.7 AND 64 MeV. Moeller, A.; Angert, N.; Franzke, B.; Schmelzer, Ch. (Univ., Heidelberg). Phys. Lett., 27A: 621-2(Sept. 23, 1968). (In German).

Cross sections for loss of one or several electrons of highly charged iodine ions in nitrogen have been measured. The probability for the loss of n electrons is approximately proportional to $\frac{1}{I}n^{-1}$. (auth)

52509 EXPERIMENTAL DETERMINATION OF ELECTRON IMPACT IONIZATION RATE COEFFICIENTS FOR NEON IONS. Mickey, Donald Lee. Princeton, N. J., Princeton Univ., 1968. 66p.

Thesis.

Rate coefficients for collisional ionization of the ions Ne^{+} through Ne^{6+} were measured in several ohmically heated hydrogen discharges of the C stellarator, with 0.25 to 4% neon added. The electron densities were between 10^{12} and 4×10^{13} cm^{-3}; electron temperatures determined from the electrical conductivity of the plasma were between 8 and 100 eV. Neon ion densities were obtained as a function of time in the discharge from measurements of the intensities of resonance multiplets in each ion, on the basis of an assumed energy dependence for the excitation cross sections. The magnitudes of the excitation cross sections were determined from approximate oscillator strengths for the transitions, adjusted to give agreement with the known total neon density and with predicted populations of metastable terms. The metastable terms were found to have near-equilibrium populations, except in Ne^{5+} and Ne^{6+}, where equilibrium populations were observed only at high electron densities. Ionization rate coefficients deduced from the time dependence of the ion densities in discharges with different density and temperature behavior agree well, but the rate coefficients for higher stages of ionization are larger, and depend less strongly on temperature, than expected. The discrepancies are probably due to a moderate (≈15%) systematic error in the conductivity temperature, and to ionization cross sections that have maxima considerably nearer threshold than was assumed. (Diss. Abstr.)

52510 CALCULATION OF THE COMPLEX ATOMIC SCATTERING FACTOR FOR FAST ELECTRONS BY USE OF HARTREE–FOCK ATOMIC POTENTIALS. Haase, Joachim (Univ., Ulm, Ger.). Z. Naturforsch., 23a: 1000-19(July 1968). (In German).

The complex scattering factors for fast electrons on six atoms using the Hartree–Fock potentials at five different acceleration voltages were calculated by the partial-wave method. An approximation method was used, which can be derived from the WBK method. Convergence corrections for the series summation of the real and imaginary parts of the complex scattering factors are given. The effect of the approximation method, the contribution of the partial-wave phases used for the summation, and the convergence corrections are discussed. To facilitate use of the tabulated values of the complex scattering factors for the evaluation of electron-diffraction patterns of molecules in the gas state, the amounts and phases of the scattering factors are expressed by analytical expressions, and the coefficients needed for approximation are given. (tr-auth)

52511 POSITRON LIFETIME MEASUREMENTS IN SOME IONIC CRYSTALS AND SOME ALKYLBENZENES. San Jose, Concepcion V. Stillwater, Okla., Oklahoma State Univ., 1967. 115p.

Thesis.

Positron lifetimes in alkali metal fluorides, potassium halides, alkaline earth fluorides, isopropylbenzene, and the butylbenzene group were measured by observing the time distribution of the two-quanta annihilation events. The standard "fast–slow delayed coincidence technique" utilizing a multichannel analyzer and a transistorized time-to-amplitude converter was adopted. The alkylbenzenes were subjected to a de-oxygenation process in an attempt to find the effects of oxygen as a quenching factor. The effects of ion radii on the properties of the annihilation processes in single crystal alkali metal halides and alkaline earth fluorides were determined. Conclusive evidence was obtained that positron bound systems can exist and persist in crystals manifesting the ionic bond. The positron short mean life is determined primarily by the halogen ion, whereas the anomalous lifetime depends on the alkali metal ion. Furthermore, it was observed that the annihilation processes in alkaline earth fluorides are similar to those in alkali metal halides. With regard to the organic compounds, the measurements could be interpreted in terms of the electron-donating ability of the substituents through the inductive effect. De-oxygenation of liquid samples exhibiting high oxygen solubility is recommended. (Diss. Abstr.)

52512 COUPLED-STATE CALCULATIONS OF PROTON–HYDROGEN SCATTERING IN THE STURMIAN REPRESENTATION. Gallaher, Donald Frederick McGeer. Seattle, Univ. of Washington, 1967. 166p.

Thesis.

The proton–hydrogen scattering problem has been solved in an improved representation called the Sturmian representation. The Sturmian functions, first brought into prominence by Rotenberg, form a denumerably infinite, complete, discrete basis set without a continuum, regardless of the interparticle potential. This permits the assessment of the importance of the continuum in its influence on the scattering cross sections and polarizations, a hitherto neglected effect. Comparison has been made with the following proton–hydrogen scattering data: discrete transfer and excitation cross sections to the 2s and 2p states due to Colli et al., and Stebbings et al., respectively, the total exchange cross section due to McClure and the notable experiments of Everhart et al., on the total transfer probability at 3°. The theoretical results show that the effect of the continuum is quite significant, resulting in improved agreement with experiment, particularly with regard to the Everhart experiment. This work is a direct extension of a previous model for the proton–hydrogen scattering problem developed by Wilets and Gallaher in which the expansion basis was purely hydrogenic. Possible extensions and improvements of the model are mentioned. (Diss. Abstr.)

52513 ANNIHILATION OF POSITRONS IN DEFORMED NICKEL-BASE ALLOYS. Adamenko, A. A.; Dekhtyar, I. Ya.; Mikhalenkov, V. S. Dokl. Akad. Nauk SSSR, 181: 68-71(July-Aug. 1968). (In Russian).

Plastic metal deformation leads to a considerable change in the angular distribution of annihilation gamma quanta. In the deformed state there is a redistribution of annihilation probabilities, as a result of which the annihilation of a positron by a conduction electron becomes more probable, while annihilation by an electron from an ionic residue becomes less probable. Gamma quanta were counted by a coincidence circuit having a time resolution of 10^{-7} sec. Nickel alloys containing 5 to 20% Co, and 2.5 to 10% Fe were counted in the deformed state and after annealing. The dislocation nuclei having local, excess negative charge represent potential holes for thermalized positrons, and simple calculations show that it is possible for a positron to be localized on a dislocation nucleus and to be annihilated there. (TTT)

52514 ELECTRON CAPTURE INTO THE 3s STATE AND 4s STATE OF HYDROGEN BY FAST PROTON IMPACT ON He, Ne, AND Ar. Dawson, Horace Ray. Fayetteville, Ark., Univ. of Arkansas, 1968. 87p.

Thesis.

Absolute cross sections for electron capture into the 3s and 4s states of hydrogen produced by proton impact on He, Ne, and Ar were measured over the energy range from approximately 2 to 120 keV. The technique involved passing protons through a differentially pumped collision chamber containing the target gas under study. In passing through this chamber protons capture electrons and become excited hydrogen atoms, which leave the collision chamber and decay in flight through an observation chamber. Intensity of H_α radiation was measured at such a position in the observation chamber that it consisted essentially of the $3s \rightarrow 2p$ transition. In a similar fashion the intensity of $H\beta$ radiation consisting essentially of the $4s \rightarrow 2p$ transition was measured. These intensities, along with measurements of gas pressure, proton flux, temperature, and various fixed parameters, allowed the calculation of the absolute cross sections for electron capture into the 3s and 4s states of hydrogen as a function of proton energy. Similarities exist among the cross-section curves for electron capture into the 4s, 3s, and 2s states (the 2s curves were determined by other investigators). Above 50 keV these curves agree well with the n^{-3} law. The 3s cross section for proton impact on He agrees well with a previous Born-approximation calculation at energies greater than 100 keV. The fractions of total electron capture into the 3s state and 4s state approach common values of 2.7% and 1%, respectively, at 100 keV for all three gases. (Disser. Abstr.)

52515 SOME ASPECTS OF ELECTRON CORRELATION IN OPEN-SHELL STATES. 2^1P AND 2^3P HELIUM. Yin, Moon-Lung; Silverstone, Harris J. (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 49: 3160-4(Oct. 1, 1968).

Accurate wave functions for the 2^3P and 2^1P states of helium have been analyzed into pair, polarization, and semi-internal correlation effects. The dynamical, transferable pair-correlation energies account for approximately 90% of the total correlation energies. The special open-shell effects, symmetry polarizations, and semi-internal correlation, account for half the remaining correlation energy. It is shown computationally that the polariza-

tion and semi-internal correlation energies can be computed separately from the pair energies to about 96% accuracy. (auth)

52516 VARIATIONAL APPROACH TO PERTURBATION THEORY. II. AN EXTENSION OF THE MINIMUM PRINCIPLE. Kolker, H. J. (United Aircraft Research Labs., East Hartford, Conn.). J. Chem. Phys., 49: 3106-9(Oct. 1, 1968).

The variational principle used to calculate the interaction of an atom or molecule with a weak electromagnetic field is cast in a form analogous to the Kato identity of atomic scattering theory. A theorem from the literature of scattering theory is then used to extend the conditions under which the vibrational approach to perturbation theory becomes a true minimum. (auth)

52517 DYNAMICS OF THE REACTION OF N_2^+ WITH H_2, D_2, AND HD. Gentry, W. R.; Gislason, E. A.; Mahan, B. H.; Tsao, Chi-wing (Univ. of California, Berkeley). J. Chem. Phys., 49: 3058-71(Oct. 1, 1968).

Product-velocity-vector distributions have been determined for the reactive and inelastic scattering of N_2^+ by H_2, D_2, and HD. These distributions show that the reaction proceeds by a direct short-lived interaction rather than by a long-lived collision complex. Most products are scattered in the original direction of the N_2^+ projectile at a speed somewhat greater than calculated from the ideal stripping model. The internal excitation of N_2D^+ and N_2H^+ is very high and decreases somewhat with increasing scattering angle. For HD there is an isotope effect that favors N_2H^+ by large factors at small scattering angles, and N_2D^+ by smaller factors at large angles. The N_2^+ scattered from D_2 shows very little elastic component, but does reveal an inelastic process that is probably the collisional dissociation of D_2. (auth)

52518 RADIAL INTEGRALS FOR THE ATOMIC MANY-BODY PROBLEM. Roberts, P. J. (Univ. of Manchester, Eng.). J. Chem. Phys., 49: 2954-60(Oct. 1, 1968).

A full analysis is presented of the radial integrations arising from certain two-, three-, and four-electron integrals for correlated wavefunctions, assuming only pair correlations between the electrons in an atom. (auth)

52519 DIPOLE SHIELDING FACTOR IN HARTREE–FOCK THEORY. Chang, Edward S. (Goddard Space Flight Center, Greenbelt, Md.). J. Chem. Phys., 49: 2904-7(Oct. 1, 1968).

In the coupled Hartree–Fock approximation, the dipole shielding factor is proved to be identically N/Z for any atomic S state. This suggests that variational-perturbation methods that yield poor values of the shielding factor may give unreliable Hartree–Fock values for other atomic properties such as the polarizability. (auth)

52520 VIBRATION–ROTATION INTERACTION EFFECTS IN CALCULATED FRANCK–CONDON FACTORS. I. THE IONIZATION OF H_2 AND D_2. Villarejo, Don (Univ. of Chicago). J. Chem. Phys., 49: 2523-32(Sept. 15, 1968).

Computed Franck–Condon factors for the ionization of H_2 and D_2 are reported, which include previously neglected vibration–rotation interaction effects. Eigenfunctions were obtained by direct solution of the Schrödinger equation in which the exact centrifugal potential is explicitly included. Only $v'' = 0$ and small K'' states of the neutral molecule have been considered and attention is confined to those transitions for which $|K'' - K| = 0, 2$. The results show a clear dependence of the computed Franck–Condon factor on rotational quantum number. For $K'' = K$, this effect is small except for transitions to the uppermost vibrational states of the ion. For $|K'' - K| = 2$, the effect is substantial even for transitions to low-lying vibrational states of the ion. By using a sum rule, it is shown that the probability of dissociative ionization exhibits a similar dependence on rotational state. Comparison of the present results for the case $K'' = K = 0$ with previous computation shows that adiabatic corrections for nuclear motion, explicitly included in this work, have a wholly negligible influence on computed Franck–Condon factors. (auth)

52521 PERTURBATION TREATMENT OF THE HELIUM GROUND STATE WITH CORRELATION IN ZEROTH ORDER. Lebeda, C. F. (Univ. of Iowa, Iowa City); Schrader, David M. J. Chem. Phys., 49: 2547-50(Sept. 15, 1968).

Pluvinage's method for calculating correlation energies of two-electron atoms is modified so that a consistent perturbation calculation becomes possible. Correlation is thereby introduced into the wave function in zeroth order, and the cusp conditions between all pairs of particles are satisfied in zeroth order. The first-order wave function is estimated variationally, and the resulting energy to third order is compared with that of Scherr and Knight and Midtdal for the systems H^-, He, and Li^+. The sensitivity of certain calculated properties to the accuracy of the first-order wave function is examined in the case of He. (auth)

52522 SOFT-SPHERE MODEL FOR CLOSED-SHELL ATOMS AND IONS. Gilbert, T. L. (Argonne National Lab., Ill.). J. Chem. Phys., 49: 2640-2(Sept. 15, 1968).

Recent spectroscopic data for the alkali metal halide monomers are used to show that approximate additivity rules of the form $R_{ij} = R_i + R_j$ and $p_{ij} = p_i + p_j$ hold for the radii and hardness parameters in the Born–Mayer repulsive potential, $U_{ij}(R) = fp_{ij} \exp[(R_{ij} - R)/p_{ij}]$. (auth)

52523 PHOTOIONIZATION OF YTTERBIUM: 1350 TO 2000 A. Parr, Albert C.; Elder, Fred A. (Univ. of Chicago). J. Chem. Phys., 49: 2665-7(Sept. 15, 1968).

A photoionization mass spectrometer was used to measure the photoionization efficiency of ytterbium from 1350 to 2000 Å. The spectrum is dominated by line structure that tentative analysis indicates is due to the following configurations: $4f^{14}5dnp$,$4f^{14}6pnd$, $4f^{13}6s^2nd$, and $4f^{13}5d6snd$. The ionization potential derived for Yb I from Rydberg series is 6.25 ± 0.01 eV. (auth)

52524 COLLISION-INDUCED DISSOCIATION OF HD^+ BY RARE GASES. Rozett, R. W.; Koski, W. S. (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 49: 2691-5(Sept. 15, 1968).

Absolute cross sections and kinetic isotope ratios for the dissociation of HD^+ into protons and deuterons when striking helium, neon, argon, krypton, and xenon are reported up to 50-eV incident kinetic energy. The calibration of the tandem mass spectrometer is described in detail. The spectator mechanism for ion–molecule reactions has been elaborated to account for the periodic maxima observed in the cross sections of these collision-induced reactions. (auth)

52525 EXPERIMENTAL DETERMINATION OF THE EFFECTIVE CROSS SECTION FOR THE EXCITATION OF THE CHARACTERISTIC X RADIATION IN BOMBARDMENT WITH α PARTICLES. Komarek, Peter (Technische Hochschule, Vienna). Acta Phys. Austr., 26: 317-26(1967). (In German).

With the help of a ^{210}Po radiation source, the effective cross section for the excitation of the characteristic K x radiation was determined by α-particle bombardment on the elements Mo, Cu, Ni, Fe, Cr, and Ti. The particle energy was variable up to a maximum value of 5.3 MeV. Whereas the effective cross section in Mo was only one barn, it increases in Ti to 116 b at 5.3 MeV α energy. The x-radiation excitation was also much larger with decreasing atomic number. A comparison of the measurement with the results of quantum theoretical calculations was satisfactory with consideration of the Auger effect. (tr-auth)

52526 X-RAY EMISSION IN THE ENERGY RANGE 100 eV TO 1000 eV. van Ark, H. J.; van de Rotte, J. (Utrecht State Univ.). Vakuum-Tech., 17: 173-7(Sept. 1968). (In German).

The x-ray emission of a target, bombarded by electrons, was measured for various target materials. A Mo photocollector was used as a detector. The x-ray yield appears to be a periodic function of the atomic number Z. The relationship between the x-ray yield and the energy levels of the target material is discussed. (auth)

52527 MEASUREMENT OF THE POLARIZATION OF EXTREME ULTRAVIOLET SYNCHROTRON RADIATION WITH A REFLECTING POLARIMETER. Rosenbaum, G. (Univ., Munich); Feuerbacher, B.; Godwin, R. P.; Skibowski, M. Appl. Opt., 7: 1917-20(Oct. 1968).

The polarization of extreme uv light provided by a normal incidence monochromator used with synchrotron radiation from the 6-GeV electron synchrotron DESY has been measured. The measured polarization increases from 82% at 500 Å to 87% at 1000 Å, and is in excellent agreement with the calculated polarization of the light incident upon the monochromator grating. A reflecting polarimeter consisting of a polarizer and an analyzer each made of four gold mirrors has been used in the measurement. (auth)

52528 INVESTIGATION OF THE FINE STRUCTURE OF THE C_2 HIGH-PRESSURE BANDS. Meinel, H.; Messerle, G. (Deutsche Versuchanstalt fuer Luft- und Raumfahrt, Stuttgart). Astrophys. J., 154: 381-4(Oct. 1968).

The rotational analysis was carried out for five bands of the high-pressure system of $C_2(A^3\Pi_g[v = 6]–X'^3\Pi_u)$. Rotational perturbations caused by two different states were observed in the upper state. The intensity distribution both for the rotational levels in the $A^3\Pi_g[v = 6]$ state and among the comparatively weak bands emitted from $v' < 6$ is in obvious contrast to the emission of the Swan system. The reason for the selective excitation of the high-pressure bands is discussed. (auth)

52529 INTENSIFICATION OF ELECTROMAGNETIC WAVES BY SYSTEMS IN WHICH THE TRANSITION FREQUENCIES ARE EQUAL. Gal'tsov, D. V. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 143-4(1968). (In Russian).

Systems in which the transition frequencies depend on the energy and other parameters of motion (such as the motion of a relativistic electron in a homogeneous magnetic field) can be used for the amplification of electromagnetic radiation. It is shown that even when the transition frequencies are equal, the emission of radiation prevails over absorption at a slight difference from the resonance frequency, since the transitions with absorption and emission of radiation take place between different levels. Expressions are given for the probabilities of emission and absorption of radiation per unit time. The radiated power is obtained by using the difference of the above two expressions. (TTT)

52530 TEMPERATURE DEPENDENCE OF THE HYPERFINE COUPLING OF $(^{155}Gd)^{3+}$ IN THORIUM OXIDE. Calvo, R.; Isaacson, R. A. (Univ. of California, San Diego, La Jolla). Phys. Lett., 27A: 713-4(Oct. 7, 1968).

The temperature dependence of the hyperfine constant of $(^{155}Gd)^{3+}$ was measured and is compared to existing theory. (auth)

52531 APPLICATION OF EFFECTIVE TENSOR OPERATORS TO LEVEL CROSSING. Kretzen, H.; Walther, H. (Technische Univ., Hanover). Phys. Lett., 27A: 718-19(Oct. 7, 1968).

Tensor operator techniques are used in order to calculate the size and the shape of level-crossing signals. (auth)

52532 POSITRON LIFETIMES IN SOLID AND LIQUID METALS. Brandt, W.; Waung, H. F. (New York Univ., N. Y.). Phys. Lett., 27A: 700-1(Oct. 7, 1968).

The observed changes of positron lifetimes in Na and Ga on melting are at variance with the predictions of the free electron gas model. They appear to be determined by the increase in vacancy concentration on melting. (auth)

52533 TEMPERATURE DEPENDENCE OF THE ANNIHILATION RATE OF POSITRONS IN ARGON GAS. Miller, D. B.; Orth, P. H. R.; Jones, G. (Univ. of British Columbia, Vancouver). Phys. Lett., 27A: 649-50(Oct. 7, 1968).

A temperature dependence of the positron annihilation rate in argon gas has been found. A 28% decrease in the annihilation rate occurs when the temperature is raised from 140 to 480°K. (auth)

52534 CALCULATIONS OF THE ENERGY LOSSES OF FAST ELECTRONS IN THIN FOILS WITH RETARDATION. Kroeger, E. (Univ., Hamburg). Z. Phys., 216: 115-35(1968). (In German).

The retardation of the electromagnetic field is taken into account in deriving a semiclassical formula for the energy-loss probability of fast electrons penetrating a thin foil with a dielectric constant $\epsilon = \epsilon(\omega)$. This formula is discussed for the special cases of the free-electron gas and the occurrence of Čerenkov radiation in substances with high dielectric constants. Numerical evaluations have been made for these cases. Significant deviations from the formula without retardation are found, which are confirmed by the experiments. (auth)

52535 NUMERICAL COMPARISON BETWEEN RELATIVISTIC AND NONRELATIVISTIC THEORY FOR SCATTERING OF SLOW ELECTRONS FROM ATOMS. Meister, H. J.; Weiss, H. F. (Univ., Munich). Z. Phys., 216: 165-71(1968).

By means of the results for phase shifts, differential cross sections, and spin polarization in scattering of slow electrons from screened Hg, Xe, and Ar nuclei the Mott theory is compared with its nonrelativistic approximation. For electron energies below 200 eV an increasing agreement of the results of the two theories with decreasing atomic number of the scatterer is found; for Ar both theories yield the same result. (auth)

52536 TABLE OF POSITRON ANNIHILATION DATA. Hogg, B. G. (Univ. of Manitoba, Can.); Laidlaw, G. M.; Goldanskii, V. I.; Shantarovich, V. P. At. Energy Rev., 6: 149-212(May 1968).

A portion of this table was compiled and circulated privately by B. G. Hogg as part of the Positrons Programs International in 1965. The table has been updated to midyear 1967. The compilers of the table have a primary interest in chemical physics and hence there may be certain omissions of data in areas not directly concerned with this field, for example, of data on the gamma-ray angular correlation measurements on metals and alloys. A further list of references is given at the end of the paper "Physical Chemistry of the Positron and Positronium" by V. I. Goldanskii. (At. Energy Rev., 6: 3-148 (1968)). (auth)

52537 RANGE OF β-PARTICLES IN MATTER. pp 6-9 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The distance that a particle can travel in matter is determined by its energy, mass, charge, and the characteristics of the matter. There is sufficient evidence to ascribe the interaction of low-energy β-particles with matter to nearly completely electronic processes. Calculations based on involved mathematical parameters conform quite closely to experimental evidence for a 2.5 μ range for β-particles in biological materials. (E.R.B.)

52538 PHYSICAL CHEMISTRY OF THE POSITRON AND POSITRONIUM. Goldanskii, V. I. (Inst. of Chemical Physics, Moscow). At. Energy Rev., 6: 3-148(May 1968).

The use of positron annihilation as a tool for investigating the physical and chemical properties of matter is surveyed. The author describes the general properties of positrons, the pattern of positron slowing-down in matter, and the formation of the hydrogen-like atom called positronium and its properties. Three types of positron annihilation are considered: annihilation in free collisions with electrons, in positronium atoms, and in compounds formed by positrons with atoms and molecules. The physical and chemical information to be derived from each of these annihilation mechanisms is analyzed. The review examines the basic experimental methods of observing positron annihilation which make it possible to distinguish the characteristics of the different mechanisms. Data on inhibition of positronium formation are surveyed, and the possibilities offered by their use as a source of information on the mechanisms of electron slowing, ionization, and excitation of molecules are considered. Experiments on positronium quenching are described and lines of research are suggested in which quenching could be used to investigate the kinetics of the reactions of hydrogen-like atoms in gases and condensed materials. The main results of research on electron momentum distributions, using measurements of the angular correlation of annihilation gamma rays, are also described. 286 references. (auth)

52539 MINIMA OF GENERALIZED OSCILLATOR STRENGTHS. Kim, Yong-ki (Argonne National Lab., Ill.); Inokuti, Mitio; Chamberlain, George E.; Mielczarek, S. R. Phys. Rev. Lett., 21: 1146-8(Oct. 14, 1968).

Zero or near-zero minima of the generalized oscillator strength occur frequently, and their positions are related to the nodes of the radial wave functions for the states involved. Some general implications of the minima are discussed, and, as an example, experimental and theoretical results for a transition in Xe are presented. (auth)

52540 QUANTUM KINETIC EQUATION FOR ELECTRONS WITH MAGNETIC INTERACTIONS. Krizan, John E. (Univ. of Vermont, Burlington). Phys. Rev. Lett., 21: 1162-3(Oct. 14, 1968).

The quantum kinetic equation appropriate to the Darwin Hamiltonian is derived by a method identical to that given earlier in deriving the classical kinetic equation, with a redefinition of operators. It is conjectured that the transverse interaction term may lead, as in the classical case, to a long-ranged effective interaction. (auth)

52541 SPECTROSCOPY OF INNER ATOMIC LEVELS: ELECTRIC FIELD SPLITTING OF CORE $p_{\frac{1}{2}}$ LEVELS IN HEAVY ATOMS. Novakov, T.; Hollander, J. M. (Univ. of California, Berkeley). Phys. Rev. Lett., 21: 1133-6(Oct. 14, 1968).

Splitting of atomic core $p_{\frac{1}{2}}$ levels caused by internal electric field gradients have been observed in compounds of Th, U, and Pu by means of photoelectron and internal-conversion spectroscopy. The magnitude of the splitting varies with the element and specific compound examined, and it may be considerably enhanced by application of a strong external field. (auth)

52542 ENERGY ANALYSIS OF ELECTRONS FROM PENNING IONIZATION PROCESSES. Fuchs, V.; Niehaus, A. (Univ., Freiburg, i. B.). Phys. Rev. Lett., 21: 1136-9(Oct. 14, 1968).

The energy of electrons released in collisions of metastable rare gas atoms with various gases is measured by means of a retarding potential field. The energy distributions obtained show a marked influence of the interaction forces between the colliding particles. (auth)

52543 BRUECKNER-GOLDSTONE MANY-BODY THEORY FOR THE HYPERFINE STRUCTURE OF PHOSPHORUS. Dutta, N. C.; Matsubara, C.; Pu, R. T.; Das, T. P. (Univ. of California, Riverside). Phys. Rev. Lett., 21: 1139-43(Oct. 14, 1968).

The Brueckner-Goldstone many-body perturbation theory is utilized to study the hyperfine interaction in atomic phosphorus. By this method, a correlation contribution to the hfs constant of a positive sign and an appropriate magnitude is obtained, which predominates over the negative core-polarization effect to produce substantial agreement with experiment. (auth)

52544 EXACT COMPUTATION OF THE VAN DER WAALS CONSTANT FOR TWO HYDROGEN ATOMS. O'Carroll, Michael;

Sucher, Joseph (Univ. of Maryland, College Park). Phys. Rev. Lett., 21: 1143-6(Oct. 14, 1968).

An exact formula is obtained for C_{HH}, the van der Waals constant that appears in $V_{HH} = -C_{HH}/R^6$, the London potential for two hydrogen atoms. Numerical evaluation gives $C_{HH} = 6.4990267 \pm 0.0000004$. (auth)

52545 HYPERFINE MAGNETIC FIELDS AT ^{119}Sn IN ERBIUM. Price, D. C.; Street, R. (Monash Univ., Victoria, Australia). J. Phys., C (London), 1: 1258-62(Oct. 1968).

^{119}Sn Moessbauer spectra were measured for a dilute SnEr alloy (<0.03 at. % Sn). It is shown that the results obtained with the alloy in the conical ferromagnetic (low-temperature) and sinusoidal antiferromagnetic (high-temperature) phases are consistent with the known magnetic structures of these phases if it is assumed that the hyperfine field at each ^{119}Sn nucleus is proportional to the host magnetization at its site. At 4.2°K the magnitude of the single-valued hyperfine field acting on all the ^{119}Sn nuclei was found to be (124 ± 4) kG. (auth) (UK)

52546 PRODUCTION OF HIGH-ENERGY NEUTRAL ATOMS BY SCATTERING OF IONS AT SOLID SURFACES AND ITS RELATION TO SPUTTERING. Brodie, I.; Lamont, L. T. Jr.; Jepsen, R. L. (Varian Associates, Palo Alto, Calif.). Phys. Rev. Lett., 21: 1224-6(Oct. 21, 1968).

Experiments performed with an rf-induced gas discharge demonstrate the existence of neutral atoms with sufficient energy to cause secondary emission of electrons. Evidence is presented that these energetic neutrals are produced by ion neutralization and reflection at the target electrode surface. (auth)

52547 PREDICTED ANGULAR DISTRIBUTION FOR RESONANT SCATTERING OF ELECTRONS BY MOLECULES. Bardsley, J. N.; Read, F. H. (Univ. of Manchester, Eng.). Chem. Phys. Lett., 2: 333-6(Sept. 1968).

The angular distributions are predicted for several resonant states occurring in the scattering of electrons by H_2, N_2, CO, NO, O_2, CO_2, C_2H_2, C_2H_4 and C_6H_6. (auth)

Cosmic Radiation

Refer also to abstracts 51218, 51223, 51250, 52347, 52424, 52631, 52915, 52928, 52966, and 52970.

52548 (AD-672310) EFFECT OF THE INTERPLANETARY MAGNETIC FIELD ON THE PROPAGATION OF COSMIC RAYS. Final Report, March 1, 1965–August 31, 1967. McCracken, Kenneth G. (Southwest Center for Advanced Studies, Dallas, Tex.). Feb. 20, 1968. Contract AF19(628)-5028. 16p. (AFCRL-68-0219). CFSTI.

A study of cosmic-ray propagation in the interplanetary magnetic field using spacecraft and neutron-monitor data is reported. Improved methods have been developed for mapping cosmic-ray flux as a function of direction and time. This cosmic-ray mapping technique made possible a detailed study of the Forbush decrease observed on January 20, 1966. Numerical filtration techniques developed for the purpose were used to study demidiurnal and diurnal components of cosmic radiation. Two distinctly different anisotropies were identified in the course of studying the interrelationship of cosmic-ray anistropy and the interplanetary magnetic field. One anisotropy is due to convective removal of cosmic radiation from the solar system by the radial flow of the solar wind. The other is due to diffusion of the cosmic radiation parallel to the lines of force of the interplanetary magnetic field. Temporal variability of Pioneer VII data during high-counting-rate periods has been studied. Study of some five days of data indicates continuous fluctuation of the cosmic-radiation flux with periods as short as five minutes occurring frequently. No diminution of fluctuation amplitude with time was observed. (auth) (USGRDR)

52549 (AD-672326) METHOD TO MEASURE GALACTIC GAMMA RAYS AND ELECTRONS. Dally, E. G. (Stanford Univ., Calif. High-Energy Physics Lab.). Apr. 1968. Contract Nonr-225(67). 7p. (HEPL-562). CFSTI.

A knowledge of the galactic gamma-ray and electron flux is of importance in understanding and explaining cosmological phenomena. Until now, few measurements of these fluxes have been conducted. The scope of the measurements made on gamma rays has been confined to very low or intermediate energies (<1 GeV). The electron flux has not been measured above a few MeV. Recent detector developments in high-energy physics now permit a simple and straightforward search for the shower-producing components (e-, γ) of the cosmic-ray flux. (USGRDR)

52550 FORBUSH DECREASE IN COSMIC RAYS AND THE TRANSIT TIME OF THE MODULATING CLOUD. Harang, L. (Inst. for Theoretical Astrophysics, Oslo). Planet. Space Sci., 16: 1095-1101(Sept. 1968).

Fifteen cases of Forbush decreases and their associated solar flares were analyzed using the method of superimposed epochs for estimating the tendency of recurrence between the flares and the Forbush decreases. The fifteen events are divided into two classes. Eleven events are characterized as the simple type, consisting of one single sharp dip with a smooth recovery up to the undisturbed niveau. For this type the assembly of flares preceding the mean Forbush decrease lies concentrated within a time interval of 2.2 to 3.2 days before the sharp decrease, with a maximum in recurrence at 2.7 days transit time corresponding to a mean particle speed of 640 km/sec. This simple type of event was thus produced through a particle-cloud ejection from one single flare. The mean curve of the dip for this simple type shows an exponential-like decrease down to 2.8% and a recovery up to normal niveau with time constants of respectively 4 hr and 3.2 to 3.5 days. Four great events were characterized as composite events; in these cases the associated flares appear almost evenly distributed over the surrounding days, ranging from 3 to 4 days before to 7 to 8 days after the Forbush decrease. The composite events, which lasted with almost uniform depression 7 to 8 days after the dip, were therefore produced by successive series of solar flares, and the mean maximum decrease of the composite type was 7%. When comparing the onset of the Forbush decrease with the position of the SC of geomagnetic storm, the SC appears in mean about 3 hr before the sharp onset of the Forbush decrease. (auth) (UK)

52551 ANISOTROPIES OF GALACTIC COSMIC RAYS IN THE SOLAR SYSTEM. Patel, D.; Sarabhai, Vikram; Subramanian, G. (Physical Research Lab., Ahemedabad, India). Planet. Space Sci., 16: 1131-46(Sept. 1968).

At least four processes appear capable of contributing to the creation of an anisotropy of galactic cosmic rays in interplanetary space. All need not necessarily be active on a particular day to the same extent. The processes are: (1) azimuthal streaming, (2) streaming due to nonuniform diffusion in a longitudinal sector structure, (3) the scattering at irregularities along the interplanetary magnetic field, and (4) latitudinal gradients in a relatively smooth magnetic field. The characteristics of the daily variation which must be expected from each process are quantitatively evaluated. Observational evidence derived from measurements of the daily variation from a network of super neutron monitors is used to derive, with precision, the spectrum of variation, the amplitude and the principal direction of maximum and minimum intensity in interplanetary space, on each day during 1964–65. The experimental results are compared with predictions in order to derive conclusions as to the process which operates on individual days. It is demonstrated that the diurnal and the semidiurnal components of the anisotropy have characteristically different energy spectra of variation. The predominant process responsible for the diurnal component is the azimuthal streaming, while the semidiurnal component appears to be due to scattering at magnetic field irregularities and latitudinal gradients. The manner in which the results can be used to derive the threshold energy below which isotropic diffusion seems to occur on individual days in the inner solar system is demonstrated. The results of the study strongly support the postulate of a gradient of galactic cosmic rays in the solar system perpendicular to the ecliptic. (auth) (UK)

52552 GAMMA RADIATION FROM CELESTIAL OBJECTS. Fazio, G. G. (Harvard Coll. Observatory, Cambridge, Mass.). Annu. Rev. Astron. Astrophys., 5: 481-524(1967).

Detection and interpretation of the electromagnetic spectrum in the extreme high-frequency range (γ radiation), E > 100 keV ($\nu > 2.42 \times 10^{19}$ sec^{-1}, $\lambda > 0.124$ Å) are reviewed. Measurement of the flux, energy spectra, and arrival direction of γ rays is being used to help solve some of the most fundamental problems of cosmology, such as the origin of cosmic rays, density of cosmic radiation in the Galaxy and in intergalactic space, density and composition of galactic and intergalactic matter, presence of antimatter in the Universe (in particular the hypothesis of the continuous creation of matter), and strength of galactic and intergalactic magnetic fields. This survey indicated that if appreciable quantities of antimatter exist in the metagalaxy, they must be located in regions that are separated from matter. The high-energy intergalactic electron intensity is less, at least by a factor of 10, than the galactic density, on the basis of the expected γ-ray flux due to Compton scattering by high-energy electrons of visible light photons in intergalactic space. Upper limits to the γ-ray flux $>5 \times 10^{12}$ eV from the Crab Nebula show that the high-energy electrons in the Nebula, which generate synchrotron

radiation, are not the product of high-energy proton interactions and therefore must have been accelerated. If the electrons were the result of π-meson decay, the γ-ray flux would be ~100 times the measured upper limit. Lack of evidence for γ rays above 10^{16} eV, which are produced by photopion production, i.e., protons interacting with thermal photons, indicates that the extragalactic proton intensity above 10^{17} eV must be $<6.5 \times 10^{-2}$ of the cosmic-ray intensity at the Earth. The most accurate prediction of a diffuse flux of cosmic γ rays is that due to high-energy proton interactions in the galactic plane. The sensitivity of present experiments is within an order of magnitude of being able to detect this flux, at energies >50 MeV. Knowledge of either the presence or the absence of this flux is essential for an understanding of the origin and diffusion of cosmic rays. (BBB)

52553 COSMIC-RAY NUCLEI. Shapiro, Maurice M. (Naval Research Lab., Washington, D. C.). Astronaut. Aeronaut., 6: 6-10(July 1968).

The detection, nature, origin, and age of primary cosmic-ray nuclei are reviewed. The cosmic radiation impinging on the solar system from outer space consists predominantly of H (85%) and He nuclei, just as these 2 lightest elements are the most abundant in stars. Heavier elements comprise altogether about 1.4% of the nucleonic component in the cosmic rays. Relative abundances of the various cosmic-ray elements and the isotopic composition of them yield clues not only to their possible sites of origin, but also to their itineraries from sources to Earth and their transformation en route. Data on the relative heavy primary nuclei (HPN) abundance are given in an accompanying table. Carbon is the most abundant HPN. In general, the elements with even at. no. are more abundant than neighboring ones of odd charge. The light nuclei, however, are exceptions in this as in other respects. The remarkable abundance of the light nuclei is noted. Relative to hydrogen, they are at least 100,000 times as plentiful in the cosmic rays as in the universal distribution. Among nuclei in the third or heavy category, the Fe group is prominent, a feature that can be explained by current theories of element formation in supernova explosions. At energies near a million BeV, the primary radiation seems to be enriched in HPN; above 10^8 BeV there appears to be a paucity of HPN. Interactions of cosmic-ray nuclei with the atmosphere and attempts to establish the age of the nuclei are also considered. (BBB)

52554 APPARATUS FOR RECORDING THE LEVEL OF COSMIC RADIATION IN DECAMETER WAVE RANGE. Belikovich, V. V. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1127-32(1968). (In Russian).

Apparatus is described for measuring the radiowave absorption in the ionosphere by the radio astronomy method, for recording fluctuations of discrete radio sources, and for some other radio astronomical measurements. Antennas, noise generators, and units for a quadratic detecting of signals and for limiting of impulse noises are described in detail. (auth)

52555 COSMIC RAYS DIFFUSION IN A CLOUD OF OUTGOING SCATTERING CENTERS. Perona, Giovanni E. Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur., 102: 525-38 (1967-68).

Cosmic rays are supposed to diffuse in a spherically symmetric cloud of scattering centers with radial speed. These centers are assumed to behave like perfectly elastic scatterers of particles in a frame of reference moving with their own radial speed. The Boltzmann equation appropriate to this situation has been obtained by Gleeson and Axford. The solution of that equation when the scatterer's velocity is much smaller than the particle's velocity, is given in the present work. Some of the terms of the distribution function expanded in powers of the scatterer's velocity are explicitly obtained, taking into account relativistic effects. (auth)

Direct Energy Conversion

Refer also to abstracts 51043 and 51176.

52556 (ANL-7425, pp 172-89) ENERGY CONVERSION. (Argonne National Lab., Ill.).

ELECTRIC CELLS—development of thermally regenerative, with lithium and sodium anodes for direct energy conversion; characteristics of lithium/tellurium, at 470 to 480°C; characteristics of lithium/selenium, with and without iron addition for current collection

LITHIUM ALLOYS & SYSTEMS—Li-Te, electromotive force in fused-salt cell at 400 to 570°C; Li-Sn, vapor pressure of, transpiration measurements of

ALKALI METAL HALIDES—survey of binary and ternary mixtures of, for thermally regenerative cells

PHASE DIAGRAMS—calculation for reciprocal salt pairs

LITHIUM FLUORIDES—LiF-KCl, phase diagram calculation for reciprocal system; LiF-LiI, phase diagram of, crystallization temperatures in

LITHIUM CHLORIDES—LiCl-LiI, phase diagram of, crystallization temperatures in; LiCl-LiF-LiI, phase diagram of, crystallization temperatures in

MERCURY IODIDES—HgI_2-KI, spectrum at 130°C, Raman

ELECTROLYTES—preparation and testing of immobilized lithium-halide paste, in bimetallic cells

LITHIUM ALUMINATES, LITHIUM ZIRCONATES—testing for use as electric insulator in lithium cells

IRON—solubility in selenium at 400 to 500°C

SELENIUM, TELLURIUM—compatibility testing with potential cell materials at 400 and 500°C

COPPER—compatibility testing with selenium at 400°C

MOLYBDENUM ALLOYS & SYSTEMS—Mo-W, compatibility testing with selenium at 400°C

TUNGSTEN, MOLYBDENUM—compatibility testing with selenium and tellurium at 400 and 500°C (D.L.C.)

52557 (CONF-680704-3) Hg AND Cs AS WORKING MEDIA FOR STUDIES OF CERTAIN PROPERTIES OF MHD GENERATORS WORKING IN A RANKINE CYCLE. Kereev, Ya. A.; Karpukhin, V. T.; Nedospasov, A. V. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). [1967]. 13p. (SM-107/130). Dep.

From Symposium on Magnetohydrodynamic Electrical Power Generation, Warsaw, Poland.

The results of the experimental and theoretical investigations aimed at the characteristics of the Hg-Cs plasma in crossed electrical and magnetical fields are described. Calculations are shown for MHD generators with the real (turbulent) conductivity in nonequilibrium plasma, and estimations of achievable efficiency and the degree of efficiency of the plant working with these media are made. (auth)

52558 (IPP-3/68) THE EFFECT OF THE ELECTRODE GEOMETRY ON THE CURRENTS AND POTENTIALS IN MHD GENERATORS. Salvat, M. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1968. 16p. (In German). Dep.

The effect of electrode segmentation on the performance characteristics of MHD generators can be found by means of simple physical considerations. Simple expressions are derived which give the efficiency of an MHD generator as a function of the geometry and the Hall parameter. (auth)

52559 OPTIMAL MAGNETIC FLUX DISTRIBUTION FOR CONDUCTION MHD MACHINE IN STATIC REGIME. Grinberg, G. K.; Zander, Yu. K.; Bandere, Z. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 3, 95-100 (1968). (In Russian).

The optimal distribution of magnetic flux in the working zone of a MHD machine is dealt with in order to obtain the maximum of the ponderomotive force. The useful current density distribution in the working zone is calculated. A dimensionless function $\overline{F}$, which characterizes the rationality of the magnetic flux distribution, is proposed. It is shown that the magnetic flux distribution, $B \sim j_Y$, gives rise to a considerable increase of $\overline{F}$, comparing with the possibly greatest value of $\overline{F}$ in the case of a homogeneous field. (auth)

52560 EXPERIMENTS ON THE MHD GENERATOR ETL MARK II. REPORT I. Fushimi, Kozo; Ikeda, Shigeru; Masuda, Toshihisa; (and others). Denki Shikensho Iho, 32: 477-82(1968). (In Japanese).

The apparatus of combustion-driven Faraday-type MHD generator ETL Mark II and results of some experiments made on it are described. Apparatus has been constructed to investigate the characteristics of the MHD generator, in which the MHD effect is dominant in comparison with the viscous one. The thermal input of this combustion chamber is about 30 MW. The fuel is diesel oil, the seeding material is potassium hydroxide dissolved in methyl alcohol, and the oxidizer is oxygen. The cross-sectional area of the generator channel is 9×11 cm^2 at the inlet and 9×25 cm^2 at the outlet; the length of the channel is 120 cm. The electrical output of 540 kW is generated at 2.26 kg/sec of the mass flow rate and 3.4 Wb/m^2 of the magnetic flux density, the gas velocity being supersonic all along the generator channel. (Bull. Electrotech. Lab.)

52561 OPTIMIZATION OF MHD GENERATOR WITH LIMITATION ON THE ANGLE OF THE CHANNEL MOUTH. El'kin, A. I. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 91-6 (Apr.-June 1968). (In Russian).

Problems in the development of a MHD generator of minimum length for a given power are examined. With the purpose of guar-

anteeing the correctness of using the quasi one-dimensional approximation, a limitation was imposed on the angle of the channel mouth (neck). The mathematical problem was formulated as a problem on the optimum high speed of the mathematical theory of optimum processes. The critical Mach number, determined by the properties of the plasma, was introduced. It was established that the form of the optimum channel depends essentially on whether the flow is subcritical or supercritical, subsonic or supersonic. It is shown that the absolute size of the angle, formed by the side walls of the channel with its axis, always attains the maximum permitted value. From calculations made on the EVM it is concluded that both expanding or contracting channels, and channels with one change-over (at the beginning expanding and then contracting or at the beginning contracting and then expanding) are possible. (tr-auth)

52562 CALCULATION OF THE LOAD CHARACTERISTICS OF MHD GENERATORS. Gorb, A. M.; Gorobets, I. S.; Mazur, N. I. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 97-102(Apr.-June 1968). (In Russian).

A method for the calculation of the load characteristics of both Faraday generators and series (Montard) generators is presented, with introduction into the calculation of equations of direct load resistance (for Faraday generators) or load current (for series generators). A method for the distribution of the electrodes in the electric load is proposed, using simple switching contacts to convert to the normal regime from the Faraday generator to the equivalent series (uninterrupted flow regime), which is especially important for experimental installations. It is shown that, apart from the obvious advantages associated with the regime for reduction of the load, there is naturally a significant expansion of the subsonic (supersonic) ranges in a wide range of load adjustment in series generators. (tr-auth)

52563 COMPENSATION OF THE BOUNDARY EFFECTS AT THE ELECTRODES IN MHD ENERGY CONVERTERS. Emets, Yu. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 103-9 (Apr.-June 1968). (In Russian).

The distribution of current in the permeable electrode, through which the conducting medium is blown in anisotropically was examined. The calculation of the electric field in the vicinity of the electrode comes down to the solution of the heterogeneous Riemann–Hilbert boundary problem. The solution for the case when the current density assumes the boundary value in the final tip of the electrode is analyzed, and the conditions necessary for the blowing in of the medium in order to obtain an equilibrium distribution of the current on the electrode surface are discussed. (tr-auth)

52564 ELECTRIC CHARACTERISTICS OF A LINEAR INDUCTION MHD DEVICE WITH CONSIDERATION OF THE BOUNDARY EFFECT. Rashchepkin, A. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 110-18(Apr.-June 1968). (In Russian).

Under the assumption that the width of the channel is much less than the width of the inductor, and the fluid fills completely the space between them, the spatial distribution of the magnetic field in the channel is determined. Expressions are developed for only one component of the field, and the others are easily determined by the formula presented. By a numerical calculation, the dependence of the development of the longitudinal boundary effect on the type of winding of the inductor (regular, compensation, and two-layer winding) is shown. (tr-auth)

52565 ELECTRODE PROCESSES IN MHD GENERATORS. Adams, R. C.; Robinson, Eric (English Electric Co., Stafford, Eng.). Proc. IEEE (Inst. Elec. Electron. Eng., 56: 1519-35 (Sept. 1968).

Electrode processes strongly influence the performance and durability of an MHD generator. A theoretical analysis of these processes is made based on a model suggested by experimental work. According to these observations, current transfer at the cathode usually occurs by means of small arc spots, while at the anode the discharge covers the electrode. The basic relations resulting from an energy balance within these discharges, Poisson's equation for space charge, and the electrical and thermal boundary conditions are derived in terms of the properties of the ambient gas. The calculation of these properties for MHD duct gases is then described and special attention given to the perturbation of the ionization equilibrium resulting from charge transport within the discharge. Preliminary results of computer programs designed to carry out the calculation for open and closed cycle duct conditions are presented, and it is shown that under certain conditions the discharge part of the calculation can be presented as a unique set of curves, from which the running conditions and erosion can be calculated for any electrode material. (auth)

52566 EXPERIMENTAL STUDY OF DIAGONAL CONDUCTING WALL GENERATORS USING SOLID PROPELLANTS. Denzel, D. L.; Davis, L. J.; Wu, Y. C. L.; Muehlhauser, J.; Taylor, R. E.; Oliver, R. H.; Dicks, J. B. (Univ. of Tennessee Space Inst., Tullahoma). Proc. IEEE (Inst. Elec. Electron. Eng., 56: 1574-8(Sept. 1968).

The work reported is the result of using a special solid fuel developed as a working fluid for MHD generators by Hercules Inc. Conductivity measurements of the combustion products were made using the electrodes of the Hall channel as floating potential probes. The experimentally determined values of the average conductivity for this type of propellant were found to be in the range between 40 and 50 mho/m. Generator experiments were performed with two different types of channels operating as a Hall generator and as a 45° diagonal conducting wall generator. The generator power output was found to be 3 to 4 times higher than that achieved by even higher flow rates using conventional RP1 and gaseous oxygen for the same generator channel and magnetic field conditions. However, the power increase was insignificant for the Hall generator. The generators operated with relatively little effect observed when coatings of aluminum oxide and other chemicals from the fuel covered the interior of the channel. (auth)

52567 AN ANALYSIS OF THE ANNULAR INDUCTION MHD GENERATOR. McCutcheon, Martin J. (Univ. of Alabama, Birmingham); Akhurst, Denys O. Proc. IEEE (Inst. Elec. Electron. Eng., 56: 1584-5(Sept. 1968).

The analysis is made for a constant-amplitude traveling magnetic field interacting with a constant-velocity fluid flowing in an annular channel. The expressions for input and output densities, electrical conversion efficiency, and generator phase impedance are given. The machine parameters and effects are included through the use of ac machinery concepts. The results are then compared with those for a generator having a rectangular channel. (auth)

52568 MHD INDUCTION GENERATOR. Dudzinsky, S. J. (RAND Corp., Santa Monica, Calif.); Wang, T. C. Proc. IEEE (Inst. Elec. Electron. Eng.), 56: 1420-31(Sept. 1968).

A review is presented of the general theory of MHD induction generators. Several different approaches to the analysis of constant-velocity generators are summarized and compared, and a new mathematical model for a variable-velocity generator is presented, including digital computer solutions for the theoretical performance. The velocity distribution and boundary layer losses are considered separately, and the problem of end effect is discussed qualitatively. Recent experimental results for both separately excited and self-excited MHD induction generators are summarized, and the future of MHD induction generators is discussed briefly. (auth)

52569 AN ANALYSIS OF THE OPERATION AND STABILITY OF THE CONSTANT-VELOCITY MHD HALL GENERATOR. Carey, John H.; Hughes, William F. (Carnegie-Mellon Univ., Pittsburgh). Proc. IEEE (Inst. Elec. Electron. Eng.), 56: 1438-48(Sept. 1968).

The constant-velocity Hall-type MHD generator with segmented transverse electrode is analyzed numerically to determine the steady-state operating characteristics and the stability with respect to axially propagating magnetoacoustic waves under a constant-current constraint. The electrical conductivity and Hall parameter are represented as functions of temperature and pressure. The variations of steady-state parameters are displayed graphically and terminal characteristics are presented. Phase velocity and amplitude data for the magnetoacoustic waves are presented in terms of steady-state parameters under a short wavelength approximation. Three wave modes are predicted, two which damp and one which grows. For initially subsonic conditions, the two damped waves propagate downstream and the amplified one propagates upstream, which may cause choking. For initially supersonic flow the three waves all travel downstream. (auth)

52570 ENERGY CONVERSION. Strauss, Sheldon D. Power, 112: No. 10, 74-9(Oct. 1968).

The state of the art in energy conversion is reviewed. Topics covered are: static systems without turbines, MHD, and thermoelectric and thermionic conversion. (M.H.R.)

52571 QUESTIONS ON THE EVALUATION OF THE PROSPECTIVE ENGINEERING–ECONOMIC INDICATORS OF ELECTRIC POWER PLANTS WITH MHD GENERATORS OF THE OPEN-TYPE. Kirillin, V. A.; Rossievskii, G. I.; Sheindlin, A. E. (Inst. of High Temperature, Moscow. Moscow Engineering–Economics Inst.). Teplofiz. Vys. Temp., 6: 577-84(July-Aug. 1968). (In Russian).

The possible indicators of the thermal economics of electric power plants with MHD generators of the open type were analyzed.

The demarcation of the areas of utilization of steam turbine condensation electric power plants of the usual type, of atomic power plants, and of MHD electric power plants was discussed. (tr-auth)

52572 ANISOTROPIC INSTABILITY OF PLASMA IN MHD GENERATORS. Ganefel'd, R. V. (Inst. of Electrodynamics, Kiev). Teplofiz. Vys. Temp., 6: 641-7(July-Aug. 1968). (In Russian).

The stability of equilibrium isothermal plasma in MHD generators is examined with respect to the excitation in them of nonpotential disturbance waves. It was shown that magnetosonic waves being propagated at right angles to the current, are amplified and lead to anisotropic instability of the plasma. The anisotropic instability was observed to cause the voltage of direct-current MHD generators to oscillate. (tr-auth)

52573 EVALUATION OF THE OPTIMUM CONCENTRATION OF ADMIXTURES BEING IONIZED IN HIGH-ENERGY MHD GENERATORS. Mostinskii, I. L. (Inst. of High Temperature, Moscow). Teplofiz. Vys. Temp., 6: 714-20(July-Aug. 1968). (In Russian).

An empirical formula was proposed for the calculation of the electric conductivity of the combustion products of different fuels with admixtures being ionized. The maximum values of the conductivity σ_{max} and the optimum concentration of admixtures introduced r_k^{opt}, corresponding to the conductivity maximum, were determined for the gases of the combustion of natural gas. The effect of the method of introduction of the admixture and the degree of enrichment of the air with oxygen on the σ_{max} and r_k^{opt} is shown. (tr-auth)

52574 INVESTIGATION OF THE EFFECT OF THROTTLING ON THE EFFICIENCY OF THE RANKINE CYCLE WITH MHD GENERATORS. Ovcharenko, V. A.; Orlov, P. P.; Chernyshev, S. M. Teplofiz. Vys. Temp., 6: 595-8(July-Aug. 1968). (In Russian).

The effect of throttling on the efficiency of the Rankine cycle with MHD generators was investigated for three working materials: mercury, potassium, and lithium. It was found that for mercury, in the region of superheated vapor, the efficiency of the cycle is practically independent of the depth of the throttling, making it possible to select the upper pressure of the cycle, independent of the pressure in the MHD generator channel. For potassium and lithium, throttling leads to a decrease of the effiency of the cycle. (tr-auth)

52575 DIRECTION OF THE INVESTIGATION AND SELECTION OF THE NONMETALLIC ELECTRODE MATERIAL FOR OPEN-CYCLE MHD GENERATORS. Lyubimov, G. A. (Moscow State Univ.). Teplofiz. Vys. Temp., 6: 599-606(July-Aug. 1968). (In Russian).

Questions associated with the selection of the electrode materials for open-cycle MHD generators are examined. The effect of the magnetic field and the flow velocity on the regularity of the pre-electrode potential drop and the qualitative characteristics of the discharge are also considered. (tr-auth)

52576 CLOSED-CYCLE MHD GENERATOR AND COMPRESSOR WITH HEAVY GAS FLOW. Yakimenko, V. L. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 607-14 (July-Aug. 1968). (In Russian).

A theoretical analysis is made of a closed-cycle generator for the conversion of thermal energy into electrical energy. The cycles in which the compression of the working gas was accomplished either by means of the electric energy, produced in the generator, or in the jet compressor are examined. The work of the jet compressor requires the consumption not of electrical energy but of thermal energy. During increase of the Joule and hydraulic losses, the jet-compressor cycle can attain 10 to 15% efficiency even during those losses in which the efficiency of the converter with compressor, working from the electrical energy of the generator, becomes negative. (tr-auth)

52577 EFFECT OF SECTIONALIZING ON THE ENERGY CHARACTERISTICS OF MHD GENERATORS WITH HIGH REYNOLDS MAGNETIC NUMBERS. Asinovskii, E. I.; Kuznetsov, Yu. A. (Inst. of High Temperature, Moscow). Teplofiz. Vys. Temp., 6: 615-20(July-Aug. 1968). (In Russian).

The energy characteristics of linear MHD generators with arbitrary magnetic Reynolds numbers are examined as a function of the load factor and the degree of electrode sectionalization. (tr-auth)

52578 METHOD OF CALCULATION OF NONEQUILIBRIUM IONIZATION OF PLASMA INDUCED BY MAGNETIC FIELDS. Maksimov, A. M. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp., 6: 634-7(July-Aug. 1968). (In Russian).

The relaxation process of the nonequilibrium ionization in induced fields of MHD generators was examined. The problem was solved with consideration of the change of the gasodynamic parameters of the flow in the relation zone. By means of the mutual solution of the equations of gasodynamics and the energy balance of the electron gas, expressions were obtained for the rate of change of all flow parameters (du/dt; $d\rho/dt$; dp/dt; dT_a/dt; dT_e/dt; dn_e/dt). On an example of the numerical calculation of one of the flow regimes of an argon plasma, the substantial effect of the change of the gasodynamic parameters on the relaxation rate and on the degree of nonequilibrium of the flow was shown. (tr-auth)

52579 EFFECT OF THE BOUNDARY LAYER ON THE ELECTRICAL CHARACTERISTICS OF MHD GENERATORS. Iotkovskii, B. G.; Kirillov, V. V. (Inst. of High Temperature, Moscow). Teplofiz. Vys. Temp., 6: 585-94(July-Aug. 1968). (In Russian).

The flow of viscous, isotropic, heat-conducting media in refrigerated channels of the MHD generator is examined. On the basis of assumptions of a boundary layer of finite thickness, the dependencies of the external electrical characteristics of the MHD generator on the characteristic size of the boundary layer were deduced. The results obtained were compared with the results of the quasi one-dimensional calculations. (tr-auth)

52580 THE CHEMICAL RECOVERY MHD CYCLE. Carrasse, J. Entropie, No. 15, 47-54(May-June 1967). (In French).

A study was made of the industrial problems raised by including an MHD stage in a large thermal power station. This overall survey has resulted in an original combined MHD–steam cycle with "chemical conversion" enabling large quantities of energy to be recovered and recycled, using only known processes and ordinary materials working at moderate temperatures. In the same vein, Alsthom Co. has designed a type of electrode construction which overcomes the difficulties and limitations connected with the exclusive use of refractory oxides. Lastly, the chemical conversion process can be of decisive value for other combined cycles e.g., gas turbines and steam turbines. (auth) (App. Mech. Rev.)

52581 MERCURY HOLLOW CATHODE PLASMA BRIDGE NEUTRALIZERS. Ward, J. W.; King, H. J. (Hughes Research Labs., Malibu, Calif.). J. Spacecraft Rockets, 5: 1161-4(Oct. 1968).

In all electric thruster systems which eject positive ions, it is necessary to supply an equal number of electrons to maintain the space vehicle's electrical neutrality. It is imperative that the neutralizer be located outside the beam; it is also desirable that the voltage difference between the electron source and the ion beam be as small as possible to reduce the power input to the electron beam and to reduce the sputtering damage caused by charge exchange ions that strike the neutralizer after falling back through the beam-neutralizer potential. A unique solution to these apparently mutually exclusive conditions is to generate a "plasma bridge" to connect the cathode, located outside the beam, to the beam itself. This technique has been applied to neutralize the ion beam of a 20-cm mercury thruster. The electrons are emitted from a hollow cathode consisting of a cavity coated on the inside with barium carbonates, heated to emit electrons thermionically. Approximately 2% of the propellant vapor is diverted from the main propellant to sustain the hollow-cathode discharge. Probe measurements have indicated that the plasma inside the cathode is less than 15 V positive with respect to the emissive coating; therefore, damage from ion sputtering should be negligible over long operating periods. 8 references. (auth)

52582 EXPERIMENTAL STUDIES OF PHENOMENA ADJACENT TO ELECTRODES. Baryshev, Yu. V.; German, V. O.; Parfenov, B. V.; Solov'ev, B. S. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 119-23(July-Aug. 1968). (In Russian).

Precathode variations of potential as a function of the current flowing through gas were studied in various ranges of temperature of the electrode surface and with various electrode materials. A simplified model excluded studies of the magnetic field and studied the electric field applied to the electrodes. A dc plasmatron of 300 kV with gas stabilized arc was used as a source of a low-temperature air plasma. The gas parameters at the inlet into the operating channel area were: mean-mass temperature ~2400–2600°K, velocity ~350 to 450 m/sec, and consumption rate ~30 to 35 g/sec. The exhaust gas from the plasmatron nozzle passes through the installation containing the additional agent (potassium concentration $\psi = 0$ to 1.2%) and the forechamber. The forechamber enables the mixing of the potassium with the flow and the formation of a flow at the inlet of a 180 long and 50×18 mm^2 cross section ceramic noncooled channel. The electrode temperature is measured continually by a pyrometer and recorded.

Spectral characteristics of the photodiode ($\lambda_{eff} = 1.5\ \mu$) pyrometer are selected for minimum influence of the potassium addition. (R.V.J.)

Fluid Physics

52583 TRANSIENT MASS EXCHANGE OF HARTMANN'S FLOW. Blum, E. Ya. (Inst. of Physics and Power Engineering, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 3, 50-8(1968). (In Russian).

Transient mass exchange of isothermal and nondissipating MHD flow in a plane channel with isolated intermittent concentration changes on the walls was studied. It was found that Hartmann's velocity profile flattening resulted in a reduced time for mass-exchange stabilization at the diffusion inlet area of flow. (tr-auth)

52584 HYDROMAGNETIC DUCT FLOW: THEORY AND EXPERIMENT. Glaberson, William I. (Univ. of Oregon, Eugene); Donnelly, Russell J.; Roberts, Paul H. Phys. Fluids, 11: 2192-9(Oct. 1968).

The theory of hydromagnetic flow through a straight channel in the presence of a uniform applied external magnetic field tranverse to the direction of flow is discussed. Examples are worked for the cases of circular, elliptic, and rectangular cross sections. Experiments were performed with such ducts. In the circular and elliptical cases the potential induced across the duct was measured as a function of angle with respect to the applied field. Rectangular ducts were investigated by means of pressure gradient measurements. All results were in good accord with theory except for an aluminum rectangular duct which acted as if it were actually nonconducting, presumably due to an insulating surface layer. (auth)

52585 ELECTROMECHANICAL COSTREAMING AND COUNTERSTREAMING INSTABILITIES. Ketterer, Frederick D.; Melcher, James R. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 11: 2179-91(Oct. 1968).

The dynamics of two highly conducting, finite length streams in relative motion, coupled by a transverse electric or longitudinal magnetic field, are examined in detail. The systems may be mathematically described by two second-order coupled, hyperbolic, partial differential equations. Four classes of flow exist: (I) subcapillary, (II) supercapillary costreaming, (III) supercapillary counterstreaming, and (IV) subcapillary–supercapillary flow. The first three are considered in the present paper. The Bers–Briggs stability criterion is applied to the dispersion relation for the infinitely long system. The eigenvalue problem for class I and III flows (no eigenvalues exist for class II flow) and the complex eigenfrequencies computed. Electrohydrodynamic experiments on these systems are described and compared with the theory. Physical explanations are given for the observed instabilities. (auth)

52586 MAGNETOHYDRODYNAMIC LAMINAR BOUNDARY LAYER IN AXIALLY SYMMETRIC TWISTING FLOW. Karyakin, Yu. E. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 82-90 (Apr.-June 1968). (In Russian).

The motion in a magnetohydrodynamic laminar axially symmetric boundary layer was examined in the presence of a torque outside the flow. The imposed magnetic field is perpendicular to the walls of the channel. The problem is resolved in the inductionless approximation. The factors relating the electrical and magnetic fields to the hydrodynamic characteristics of the outer part of the flow were obtained. In the original system of equations describing the boundary layer the Stepanov transformation was used, and after utilization of the integral pulse equations, the system was converted into the generalized form. The transition from the variable (x,ξ) to the independently variable $(\xi, f_k, g_k, m_k, \varkappa_k)$ was made where x is the longitudinal coordinate; ξ is By/δ^{**}_{tot}; B is 0.46947, the normalizing constant; y is the transverse coordinate in the boundary layer, and δ^{**}_{tot} is the size of the pulse loss in the longitudinal direction. By means of the transformation indicated, a system of equations was converted into the universal form, independent of the velocity distribution at the outer part of the flow. The universal equations were integrated by the method of finite differences on a computer for the special case of local-triparameter problems where $f_2 = f_3 = \ldots = 0$, $g_2 = g_3 = \ldots = 0$, $m_2 = m_3 = \ldots = 0$, $\varkappa_2 = \varkappa_3 = \ldots = 0$, $g_1^2 m_1 = \text{const}$, $\varkappa_1 = \text{constant}$. The results are given graphically and in tables. The effect of the magnetic field on the flow in the boundary layer is shown. (tr-auth)

52587 TURBULENT SUBMERGED JETS OF ELECTROCONDUCTING LIQUID IN LONGITUDINAL MAGNETIC FIELD. Lushchik, V. G. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 77-81(Apr.-June 1968). (In Russian).

The axially symmetric turbulent submerged jets of incompressible electroconducting liquids in a one-dimensional magnetic field were examined. For the basic portion of the jet, an automodel solution was obtained with consideration of the effect of the magnetic field on the coefficient of apparent kinematic viscosity, under the assumption that the Reynold's magnetic number is small and the pressure in the jet is constant. The expressions obtained for the velocity components and the current function, correct to the numerical coefficient, in form agrees with the analogous case of turbulent jets in the absence of imposed magnetic fields. The solution obtained for the longitudinal component of the velocity is compared with experimental data. (tr-auth)

52588 UNSTEADY FLOW IN NONVISCOUS MAGNETIC BOUNDARY LAYER. Tokatly, V. I. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 65-70(Apr.-June 1968). (In Russian).

The original stages of the formation of nonviscous magnetic boundary layer during the flowing of an incompressible conducting liquid around a cylindrical dielectric body, within which are magnetic field sources, included at the original moment t = 0, were investigated theoretically. The case was examined when the flow is flat (velocity of the liquid perpendicular to the generating cylinder, vectors of the velocity and intensity of the magnetic field are in one plane) $R_m = V_0 r_0/\nu_m \gg 1$, $N_2 = H_0^2/4\pi\rho_0 V_0^2 \gg 1$, where V_0 is the characteristic velocity of the liquid, r_0 is the characteristic dimension of the body flown around, ν_m is the magnetic viscosity of the liquid, ρ_0 is the density of the liquid, H_0 is the characteristic magnetic field strength in the body. It is shown that in a series of cases the formation of vortices in the boundary layer is possible. (tr-auth)

52589 LINEARIZED ANALYSIS OF PRANDTL–MEYER MHD FLOW. Pleshanov, A. S.; Lazarev, P. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 59-64(Apr.-June 1968). (In Russian).

A solution, linearized to small parameters of the MHD interaction, was obtained for the equation of the stationary plane flow of electroconducting nonviscous and non-heat-conducting ideal gas in a transverse magnetic field at Reynold's magnetic number $Re_m \ll 1$. The equations describe the stationary rarefaction wave clear to the specific line (Prandtl–Meyer flow). (tr-auth)

52590 TRANSVERSE DISTURBANCE OF THE VELOCITY IN MAGNETOHYDRODYNAMIC CHANNELS. Apollonskii, S. M.; Kos'kin, Yu. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 53-8(Apr.-June 1968). (In Russian).

The two-dimensional flow of nonviscous, non-heat-conducting, compressible liquids with anisotropic electric conductivity in a rectangular MHD channel of constant cross section in the presence of a constant transverse magnetic field, was examined. The analytical dependences were given for the calculation of the disturbance of the parameters of the channel during subsonic flow regimes. On the basis of the analysis of the calculated results, obtained on the BZSM-2, for the range of change of the Hall parameter β_e from 0 to 10 and its comparison with data, corresponding to the calculation of the liquid flow in one-dimensional approximation, conclusions were drawn on the possibility of neglect of the transverse components of the velocity in a series of practically important cases. (tr-auth)

52591 TURBULENT TRACKS IN MAGNETOHYDRODYNAMICS. Pleshanov, A. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 49-52(Apr.-June 1968). (In Russian).

Three automodel problems of friction and heat exchange in plane stationary turbulent flow of incompressible conducting liquids in transverse magnetic field were solved for the case of absence of electric fields and small Reynold's magnetic number. It was shown that (1) the characteristics of satellite flow, at the value of the generalized coefficient of turbulent viscosity, decreases exponentially downstream; (2) the width of the tracks behind the ionizing streamline body at a great distance from the body tends toward a final size, inversely proportional to the square root of the MHD interaction parameter. Automodel problems for axially symmetric turbulent tracks were also solved. (tr-auth)

52592 FLOW IN MAGNETOHYDRAULIC TROUGH. Dzhaugashtin, K. E. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 33-44 (Apr.-June 1968). (In Russian).

The flow of conducting liquids with free surface in the trough under the effects of a transverse magnetic field was examined. Induced currents were assumed to be short-circuited and the magnetic number Re_m was assumed small. On the basis of the equations of the boundary layer, solutions were obtained by the integral method for the laminar and turbulent flow regimes. Relations connecting the intensity of the hydraulic jump and its location were obtained. The breakaway points of the boundary layer were determined. One of the particular cases examined was compared with experiments on magnetohydraulic troughs. (tr-auth)

52593 SOME QUESTIONS OF THE INVESTIGATION OF THE SYSTEM OF EQUATIONS OF ELECTROGASDYNAMICS. Bortnikov, Yu. S.; Rubashov, I. B. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 26-32(Apr.-June 1968). (In Russian).

The system of equations and boundary conditions of electrogasdynamic problems were formulated. A system of criteria, for determining the interaction of unipolar charged dielectric liquids with electric fields, was developed. The general system was particularized for the quasi one-dimensional case. Analytical solutions of the particularized system were obtained for the problems of electric convection and a comparison was made of the theoretical and experimental results. (tr-auth)

52594 IONIZED GASES FLOWING AROUND CYLINDERS WITH OSCILLATING SURFACES. Selezova, L. V. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 19-25(Apr.-June 1968). (In Russian).

Problems on the supersonic flow of weakly ionized compressed gases around an ideally conducting circular cylinder were examined. The walls of the cylinder achieve small oscillations in the axial and azimuthal directions. The effect of the viscosity was considered approximately by means of the change of the displacement model of the boundary layer. The magnetic field and the imposed flow were parallel to the cylinder axis. The Hall effect was taken into consideration. The magnetohydrodynamic equations were linearized and the functions sought were assumed in the form of resolution with respect to small Reynold's magnetic numbers. The disturbed pressure, caused by the cylinder oscillations, was determined in an explicit form. The effect of the magnetic field and the Hall effect on the modulus and pressure phase was investigated. It was shown that because of the boundary layer and the Hall effect the oscillation amplitude was increased. (tr-auth)

52595 QUESTIONS ON THE LONGITUDINAL STABILITY OF THE PLASMA FLOW BETWEEN THE CONDUCTING SCREENS IN A TRANSVERSE MAGNETIC FIELD. Kapustyanenko, G. G. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 8-12(Apr.-June 1968). (In Russian).

By means of the method of D subdivision, the characteristic equation of the small-amplitude longitudinal oscillations of the plasma in the one-dimensional flow between electromagnetic screens having finite electric resistance was investigated. It was assumed that the plasma was ideally compressible and that the original current in the plasma was absent. It is shown that, because of the presence of incomplete screening, the supersonic flow of the plasma in the transverse one-dimensional and stationary magnetic fields is unstable with respect to the low-frequency longitudinal oscillations in the range of values of the Reynold's magnetic number, calculated on the wave length, over 2. (tr-auth)

52596 PARALLEL HYDROMAGNETIC SHOCKS. Verma, B. G. Def. Sci. J. (New Delhi), 16: 259-60(1966).

It has been shown that the transition from State 1 to State 3 can be effected by a parallel hydromagnetic shock of the same strength as the ordinary fluid dynamic parallel shock. (Indian Sci. Abstr.)

52597 ELECTROGASDYNAMICS. Gourdine, Meredith C. Sci. Technol. (N. Y.), No. 79, 50-6(July 1968).

The principles and operation of the electrogasdynamic (EGD) generator are described. The EGD generator consists of a nonconducting duct through which a gas is forced to flow. Charges are sprayed into the moving gas stream by placing a pair of electrodes in the upstream end of the tube. As the gas passes through the very high electric field between the pointed electrode in the center of the duct and the electrodes in the wall of the duct, the free electrons present are attracted to the positively charged electrode, colliding with molecules in the gas, knocking off more electrons. The new free electrons will produce still more electrons until the space between the 2 electrodes is filled with large numbers of free electrons. The collisions are producing electrons, and also producing ionized molecules of the gas. These ions begin to drift toward the negative electrode, but, being heavier, much more slowly than the electrons. The heavy ions are blown downstream before they have time to drift to the negative electrode, creating a moving gas containing a large number of charged particles, a prerequisite for electrogasdynamics. The work done by the gas in pushing the positively charged particles uphill against the electric field is extracted in the form of electric power. The EGD generator resembles the magnetohydrodynamic (MHD) generator. Both convert the energy of a moving gas directly into electricity. The MHD generator does it, however, by first making the gas electrically conductive (by heating it to very high temperatures, or seeding it with easily ionized atoms, or both) and then passing this conductive gas through a magnetic field. The basic difference between an MHD generator and an EGD generator is that the former produces low-voltage, high-current d-c power, while the latter produces high-voltage, low-current d-c power. (BBB)

52598 FLAT-PLATE MAGNETOHYDRODYNAMIC BOUNDARY LAYER IN A TRANSVERSE MAGNETIC FIELD. Dukowicz, J. K.; Matthias, C. S.; DeLeeuw, J. H. (Univ. of Toronto, Can.). Can. Aeronaut. Space Inst., Trans., 1: 45-52(Mar. 1968).

The equations of motion for a flat plate boundary layer flow of an incompressible, electrically conducting fluid in the presence of a transverse magnetic field moving with the main stream velocity were solved numerically for the case of negligible induced magnetic field. The equations of motion were transformed into a universal form with no characteristic parameters present. The velocity profiles were calculated as they range from the Blasius profile to the asymptotic expotential profile. The asymptotic profile is reached in a distance $x_1 \simeq \rho U_x/\sigma B^2$ from the leading edge, where ρ is the fluid density, U the free stream velocity, σ the electrical conductivity, and B the magnetic field strength. The error due to the finite-difference solution was also calculated. In addition, calculations were made for the problem assuming local similarity of the boundary layer. The results for the boundary layer velocity profile and the wall shear compared favorably with the exact results. (BBB)

52599 MHD FLAT PLATE BOUNDARY LAYER CALCULATION METHODS: A COMPARISON. Moffatt, W. C. Can. Aeronaut. Space Inst., Trans., 1: 53-5(Mar. 1968).

A comparison was made between 2 methods of solution of flat plate boundary layer problem for an electrically conducting fluid in the presence of a transverse magnetic field. The results obtained by Dukowicz by direct integration of the boundary layer equations were compared with those obtained by a simple alternative approach, the momentum integral method. The agreement found was remarkably good. Results for wall shear stress and boundary-layer velocity distribution are presented. Thus, the integral solution for the MHD flat plate boundary layer problem yielded results which were virtually identical to those found using an exact analysis. The choice of a nonsimilar boundary-layer velocity distribution, which is known to be correct very close to and very far from the leading edge of the plate, is the key to this agreement; use of the parabolic profile, for example, led to an asymptotic value of wall shear stress, which was 20% low. The principal advantage of an integral solution for any boundary layer problem is its simplicity. The results show that, even for a complex physical situation, judicious use of the method can yield reliable results. (BBB)

52600 SELF-SUSTAINED THERMALLY DRIVEN NONLINEAR OSCILLATIONS IN ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW. Gundersen, Roy. M. (Univ. of Wisconsin, Milwaukee). Int. J. Eng. Sci., 5: 205-11(Feb. 1967).

Heat is added to the one-dimensional flow of an ideal, inviscid, perfectly conducting, monatomic compressible fluid, subjected to a transverse magnetic field in a tube closed at both ends, by means of a heater releasing energy at a rate proportional to the pressure fluctuation at the heater. The problem is similar to that studied by Chu with the additional complication of the electrical conductivity. The physical system is unstable; any pressure fluctuation in the tube will increase until shock waves are formed. The amplitude of the perturbations assumes a limiting value. Changes in flow become periodic, producing a self-sustained periodic, nonlinear oscillation, whose maintenance depends on the varying transfer of heat resulting from varying motions of the fluid through the heater. Although the pressure-sensitive heat release is of order ϵ^2, it produces an oscillation of order ϵ in the tube (ϵ is a small parameter, i.e., a term of first-order); thus the perturbation series must be carried to the second order. Entropy changes across the shocks may be neglected. The problem is studied by finding isentropic perturbations of initially uniform flows. The basic perturbation equations are valid only in the regions bounded by the wall, the heater and the various shock waves. Across the shock waves, the usual shock jump conditions must be satisified. (BBB)

52601 HYDROMAGNETIC STABILITY OF A TWO-DIMENSIONAL COMPRESSIBLE JET. Chakraborty, B. B. (Panjab Univ., Chandigarh, India). Progr. Theor. Phys. (Kyoto), 40: 210-30(Aug. 1968).

The stability of a two-dimensional jet of a perfectly conducting, compressible, and inviscid fluid in the presence of a magnetic field aligned to the direction of the fluid motion is studied for disturbances propagating along the magnetic field. Detailed analysis for long-wavelength disturbances shows that the jet is stable against these disturbances when its velocity is sufficiently large, but otherwise it will be unstable under suitable conditions. A discussion of disturbances of small wave lengths in several different cases shows that the jet is stable in these cases against these disturbances except when the jet velocity relative to the outside fluid is equal to

the sound velocity and the magnetic field is sufficiently small. (auth)

52602 OSCILLATING LAMINAR FLOW OF A CONDUCTING INCOMPRESSIBLE LIQUID UNDER THE INFLUENCE OF A TRANSVERSE MAGNETIC FIELD. Bauer, Josef; St. Schirmaier, Antonia (Univ., Vienna). Acta Phys. Austr., 26: 308-16(1967). (In German).

Appropriate to his studies on the turbulence problem, Th. Sexl in 1928 theoretically proposed a hydrodynamic effect which represented an analog to the electrodynamic skin effect and which stated that the amplitudes of an oscillating laminar flow in a circular cylindrical tube were crowded at the walls. This effect was found factual in 1929 by E. G. Richardson and E. Tyler and named the "annular effect." The present study expands these investigations to a conducting liquid under the effect of a transverse magnetic field. For small Reynolds numbers, one obtains in the present case a liquid pulsating in the tube with the period of the force maintaining the motion and with a velocity profile corresponding to the stationary flow so that the magnetic field shows no effect. For large Reynolds numbers the flow has the character of a Prandtl boundary flow so that the annular effect occurs and the magnetic field causes the maximum of the velocity to be displaced nearer to the tube wall. (tr-auth)

52603 MAGNETOHYDRODYNAMIC EFFECTS IN COMPOSITE BEARINGS. Prakash, J. J. Lubric. Technol., 89: 323-8(July 1967).

A theoretical analysis is made of a composite slider bearing using an electrically conducting lubricant, such as a liquid metal, in the presence of a magnetic field applied perpendicularly to the bearing surfaces. Two solutions are presented for large and small values of Hartmann number. It is found that for large Hartmann number, a significant increase in load capacity can be obtained even under open circuit condition. Short circuit condition results in zero load capacity, under the approximation considered. At small Hartmann number, only a slight increase occurs under open circuit condition and external power must be supplied to get a significant increase. It is seen that a magnetohydrodynamic composite bearing an equivalent inclined slider bearing, as is the case with classical composite bearing. There is a critical Hartmann number depending on the parameters of the problem, above which MHD effects reduce the load capacity as compared to the case of an equivalent inclined slider bearing. It is also observed that the frictional drag on the bearing can be made zero by supplying electrical energy through the electrodes to the fluid. (auth) (App. Mech. Rev.)

52604 MHD HYDROSTATIC THRUST BEARING: THEORY AND EXPERIMENTS. Krieger, R. J.; Day, H. J.; Hughes, W. F. J. Lubric. Technol., 89: 307-13(July 1967).

An analytical and experimental investigation is made of magnetohydrodynamic lubrication flow between parallel stationary disks in an axial magnetic field. The effect of the fluid inertia is analyzed by a single iteration of the appropriate differential equations. For a given pressure, the approximate solution indicates that the inertia forces increase the load capacity and flow rate. Experimental flow rates are obtained by varying the Hartmann number with a constant head and by varying the head with a constant Hartmann number. Good agreement is found between the theory and experimental results until the transition to turbulent flow occurs. The effect of the magnetic field on this transition is evident from the data. (auth) (App. Mech. Rev.)

52605 POSSIBILITIES OF MAGNETOGASDYNAMIC LUBRICATION. Constantinescu, V. N. J. Lubric. Technol., 89: 314-22(July 1967).

The problem of gas film lubrication is considered, by assuming the existence of an electrical conductibiltiy for the gas and the motion's subjection to the influence of external electromagnetic fields. The MGD-lubrication equations are written under a general form. Several external electromagnetic conditions are considered, divided into classes: (a) transverse magnetic field, and (b) tangential magnetic field combined with transverse electrical field. For each case, the pressure differential equation is deduced and the possibilities of obtaining approximate solutions are briefly discussed, as well as the existence of some limiting solutions. Finally, the possibilities of improving the operation of both self-acting and externally pressurized gas bearings are pointed out. (auth) (App. Mech. Rev.)

52606 MAGNETOGASDYNAMIC LUBRICATION. Constantinescu, V. N. Rev. Roum. Sci. Tech., Ser. Mecan. Appl., 11: 925-51(1966).

Magnetogasdynamic (MGD) lubrication is a quite new field of tribology, with interesting possible applications to modern technology (nuclear installations, cosmic vehicles). The paper extends magnetohydrodynamic lubrication to the field of compressible lubricants. After pointing out the possibilities of this method to reduce friction and raise the performance of gas bearings, the MGD lubrication equations are deduced under general conditions, i.e., when electromagnetic force components exist, due to the influence of both magnetic and electric fields. Inertia effects are also taken into account. Some simplifications derived from either the thin film theory or special considerations concerning the conductibility of the surfaces and then introduced. Meanwhile, different situations are considered concerning the existence of peculiar electromagnetic conditions (transverse or tangential magnetic fields only, magnetic and electric fields applied separately, and different combinations between their components). Furthermore, the velocity profiles and pressure equations are obtained assuming that two interesting external electromagnetic conditions exist, i.e., (a) transversal magnetic field with or without tangential currents and (b) transverse current with or without tangential magnetic field. For both cases, surfaces considered either as perfect conductors or insulated surfaces are taken into account. Finally, some limiting solutions are analyzed, for low and very high relative velocities. It is shown that the Hartmann number has a positive influence on the pressures in the case of a transverse magnetic field and insulated surfaces, and a negative one for conducting surfaces in short circuit. The existence of a tangential magnetic field and a normal electric one seems to be of interest in gas lubrication. Applications on slider and step bearings are presented. (App. Mech. Rev.)

52607 ALFVEN WAVES IN RELATIVISTIC MAGNETOHYDRODYNAMICS. Lukacevic, Ilija (Faculte des Sciences, Belgrade). Ann. Inst. Henri Poincare, Sect. A, 8: 217-40(1968). (In French).

A proof is obtained that the Alfvên shock waves are the only possible waves for which discontinuities of the velocity four-vector and those of the magnetic field vector are collinear. An analogous proof for the infinitesimal Alfvên waves is obtained, and the incompatibility of an irrotational motion with these waves is established. Then one considers the electrical current-sheet vector, and using it, the necessary and sufficient conditions for an Alfvên shock in general relativity are given. (auth)

52608 MANGLER'S TRANSFORMATION IN MAGNETOGASDYNAMICS. Ingham, D. B. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Mech., 35: 613-14(Sept. 1968).

One of the simplest three-dimensional problems which has considerable importance in nonmagnetic flows, the axially symmetric flow, is considered. A body of revolution fixed in a steady stream such that its axis of revolution coincides with an axis of symmetry of the flow is studied. A magnetic field aligned with the flow at infinity is applied. (M.H.R.)

52609 ONE-DIMENSIONAL STEADY MAGNETOGASDYNAMIC FLOW IN OBLIQUE FIELD AND THE STRUCTURE OF SHOCK WAVES. Helliwell, J. B. Arch. Ration. Mech. Anal., 26: 237-56(1967).

An exact solution is obtained for one-dimensional steady flow of a polytropic perfect gas with constant finite electrical conductivity under the action of an oblique magnetic field and a transverse electric field. The solution is presented in terms of elliptic functions. Many possible flow patterns, appropriate to the structure of switch-on and switch-off shock waves, are discussed in detail for the case when the transverse momentum equals the transverse Maxwell stress. (App. Mech. Rev.)

52610 STEADY LAMINAR HYDROMAGNETIC FLOW IN THE ANNULAR REGION BETWEEN TWO COAXIAL ROTATING CIRCULAR CYLINDERS WITH AN IMPRESSED RADIAL MAGNETIC FIELD. Kumar, Vijai (Roorkee Univ., India). Univ. Roorkee Res. J., 9: No. 1-2, 9-15(1966).

The magnetohydrodynamic equations arising due to the interaction between the magnetic field and the velocity field in the case of laminar hydromagnetic flow are reduced to an equation giving the pressure, another giving the velocity, and a third giving the magnetic field. An exact solution is presented in closed form, taking into account the minimum number of assumptions. (Indian Sci. Abstr.)

52611 LAMINAR STEADY-STATE MAGNETOHYDRODYNAMIC FLOW IN AN ANNULAR CHANNEL WITH SUCTION AND INJECTION AT THE CYLINDRICAL BOUNDARIES. Singh, Bani (Roorkee Univ., India). Univ. Roorkee Res. J., 9: No. 1-2, 1-7(1966).

The flow of an electrically conducting viscous fluid in the steady case in an annular channel under a constant pressure gradient along the axis of the channel reported by Olobe (Phys. Fluids 1959, 2, 404) has been extended by taking account of suction and injection at the inner and outer boundaries at the same prescribed rate. The exact solution is presented. (Indian Sci. Abstr.)

52612 APPLICATION OF THE LAPLACE TRANSFORM TO THE SOLUTION OF THE BOUNDARY LAYER EQUATIONS. II. MAGNETOHYDRODYNAMIC BLASIUS PROBLEM. Apelblat, A. (Nuclear Research Centre, Negev, Israel). J. Phys. Soc. Jap., 25: 888-91(Sept. 1968).

The boundary layer equations for the magnetohydrodynamic version of the Blasius problem are reduced to the system of simultaneous nonlinear ordinary differential equations. These equations are solved by the Laplace transform method. The obtained solution, which has a finite radius of convergence, is extended by using the steepest descent technique. (auth)

52613 NATURAL CONVECTION FLOW THROUGH A CHANNEL WITH POROUS WALLS UNDER A TRANSVERSE MAGNETIC FIELD. Agarwal, R. S. (Roorkee Univ., India). Univ. Roorkee Res. J., 9: No. 1-2, 69-79(1966).

Studies were made of the Joule losses due to a non-viscous, conducting, and thermally nonconducting gas moving in a plane channel with slightly changing geometry in the presence of a homogeneous transverse magnetic field. It was assumed that the electric conductivity and Hall's parameters for β electrons are constant, the ion gliding is negligible, and the induced magnetic field can be omitted. It was also considered that the upper and lower walls of the channel are slightly deflecting from the surfaces and these deflections slowly change along the flow. (R.V.J.)

52614 SIMILARITY SOLUTIONS FOR THREE-DIMENSIONAL LAMINAR MAGNETOHYDRODYNAMIC BOUNDARY LAYER. Filippov, G. V.; Shakhov, V. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 11-17(July-Aug. 1968). (In Russian).

The effect of magnetic field on fully developed natural convection flow between two parallel porous plates maintained at constant temperature has been considered. The flow and heat transfer are mainly governed by 4 dimensionless numbers, viz., the suction Reynolds number (R), the Prandtl number (σ), the Hartmann number (M), and a new dimensionless grp $K(=\sigma G\phi f_x h/Cp)$, where G is the Grashof's number, ϕ the coeff. of volumetric expansion, C_p the specific heat, h, the distance between the plates, and f_x the body force. It is found that both velocity and temperature decrease with an increase in M and so does also the Nusselt number (numerical value) along the walls. (Indian Sci. Abstr.)

52615 JOULE LOSSES IN A VARIABLE CROSS SECTION CHANNEL CAUSED BY INCOMPRESSIBLE GAS. Vatazhin, A. B. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 3-9(July-Aug. 1968). (In Russian).

Self-similarity solutions for three-dimensional incompressible laminar boundary layers were previously found with respect to ordinary hydrodynamics. An attempt is made here to find possible similarity solutions for magnetohydrodynamic three-dimensional boundary layers, assuming that the curvature of the surface varies only very slightly and the local boundary layer thickness is small compared to the main radius of the surface curvature. (R.V.J.)

52616 EXPERIMENTAL STUDIES OF SHOCK WAVE REFLECTION FROM A CURRENT LATTICE. Derevyanko, V. A.; Zaklyaz'minskii, L. A.; Lebedev, E. F. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 136-41(July-Aug. 1968). (In Russian).

Experimental studies were made of the reflection of a strong shock wave created in an electric discharge shock tube with coaxial arc gap, by using a magnetic field. The velocities of the refracted and reflected shock waves are found as functions of the initial magnetic field strength and conducting gas deformation of the magnetic field. It is shown that, with strong magnetic fields, the velocity of the shock wave passing through the field was three times slower than the velocity of the incident wave. The design of the experimental installation is described. The pictures taken of the shock wave interactions with the magnetic field (at axis time scale 1.5 mm/μsec and air pressure 0.7 mm Hg) showed that the velocity of the shock wave passing through the refraction shock wave lattice decreased with the increase of the initial magnetic field. (R.V.J.)

Geophysics

Refer also to abstract 52792.

52617 (AD-663441) DAILY AND SEASONAL VARIATION OF THE TOTAL ELECTRON CONTENT OF THE IONOSPHERE OVER TORTOSA. Scientific Report No. 1, March 1, 1966–March 30, 1967. Galdon Eduardo, S. I. (Observatorio del Ebro, Tortosa (Spain)). Apr. 2, 1967. Contract AF61(052)-924. 29p. CFSTI.

The total electron content of the ionosphere can be calculated from the Faraday fadings of signals received from Satellites. After an indication of the method used at Tortosa, exposure is made of the results obtained at the Station with the records of the S-66 Satellite from November 1964 until February 1966. Consideration is given to the diurnal and seasonal variation of T.E.C. and results are compared with those gathered by other authors. (auth) (USGRDR)

52618 (AD-663753) IONOSPHERIC RESEARCH USING SATELLITES. Progress Report No. 9, September 1, 1966–August 31, 1967. Lundbak, Asger N.; Mikkelsen, Ib Steen (Danish Meteorological Inst., Copenhagen. Geophysical Section). Sept. 30, 1967. Contract AT(61(052)-828. 8p. (AFCRL-67-0689). CFSTI.

Unmodulated signals from Explorer 22 on 20, 40, and 41 Mc have been recorded at two places in Denmark and Greenland. Both Faraday rotation and scintillation phenomena are very frequent in the records, so that ionospheric irregularities and total electron content can be studied in detail. This report presents a review of the activity in this respect. Further, the geostationary satellite Canary Bird is recorded on 136.44 Mc during short intervals. Such records of Canary Bird and other geostationary satellites will be strengthened in the future. (auth) (USGRDR)

52619 (AD-665775) THE SPECTRAL CHARACTERISTICS AND THE PROPAGATION IN THE MAGNETOSPHERE OF HYDROMAGNETIC EMISSIONS (PEARLS). Sill, William R. (Massachusetts Inst. of Tech., Cambridge. Geophysics Lab.). Dec. 1967. 188p. CFSTI.

Thesis.

Many of the observed characteristics of hydromagnetic emissions or pearls have been successfully explained by the propagation of the guided Alfvén wave along geomagnetic lines of force. This thesis extends some of the previous work, which has concentrated on the dispersion properties of these signals, by examining the fine structure in the spectral character of these signals. These emissions all show a very dramatic spectral feature of a series of high Q peaks. This frequency structure is present in the individual dispersed wave trains, and should not be confused with the fine structure obtained in a Fourier analysis of a series of repetitive signals. It is shown that the spectral peaks that are observed are consistent with the high order field line resonances that would be expected from models which satisfy the observed dispersion. The mode numbers are so high, being of the order 20 to 50, that one cannot expect to predict the actual frequencies observed. The observed separations between the peaks are in good agreement with those predicted from the model studies. An interpretation is proposed that the emissions are produced by the cyclotron resonance amplification of a background wave spectrum of resonant field line oscillations. (auth) (USGRDR)

52620 (AD-666953) BEHAVIOR OF A HIGH-LATITUDE HYDROMAGNETIC WAVE PHENOMENON OBSERVED AT CONJUGATE LOCATIONS. Campbell, W. H. (Earth Sciences Labs., Boulder, Colo.). Dec. 1967. 14p. (ESL-6). CFSTI.

The study is a summary of the characteristics of the pc-1 geomagnetic field pulsation phenomenon in the 0.15 to 3.5 c/s frequency range with emphasis on the behavior at auroral latitudes. That the detected emissions are manifestations of resonant hydromagnetic wave propagation on the Earth's field lines is evidenced by the preferred simultaneous occurrence at conjugate field locations. The occurrence times of high-latitude emissions indicate that the excitation is on the Sun side of the magnetosphere. The resonance frequency changes uniformly with local time. There seems to be coupling to other than field-guided propagation modes when the waves reach ionospheric altitudes. Large auroral associated absorption appreciably attenuates the signals. Present problems in understanding the pc 1 phenomenon are discussed. (auth) (USGRDR)

52621 (AD-672068) IONOSPHERIC AND MAGNETIC OBSERVATION AT BANGKOK, THAILAND DURING THE ANNULAR SOLAR ECLIPSE ON NOVEMBER 23, 1965. van der Laan, Jan E. (Stanford Research Inst., Menlo Park, Calif.). Dec. 1967. Contract DA-36-039-AMC-00040(E). 31p. (SRI-TR-32). CFSTI.

Vertical-incidence ionospheric measurements and magnetograms, made during the annular solar eclipse of November 23, 1965, are presented and discussed. A marked change in the F2-layer virtual height and considerable stratification of the F layer were observed, including formation of an F1.5 layer. The magnetograms indicate a large (approximately 25 percent) diminution relative to the normal solar disk was observed at about 1009 hours local time (0309 GMT) at Bangkok, which was approximately 290 km from the center of the eclipse path. (auth) (USGRDR)

52622 (AD-672252) THEORY OF HYDROMAGNETIC PROPAGATION IN THE IONOSPHERIC WAVEGUIDE. Greifinger,

Carl; Greifinger, Phyllis (RAND Corp., Santa Monica, Calif.). June 1968. 60p. (RM-5616). CFSTI.

A study of the propagation of low-frequency hydromagnetic waves in an ionospheric duct centered around the Alfvén speed minimum near the F2 ionization peak. An inhomogeneous waveguide is considered in the presence of a uniform magnetic field, the case treated being that of horizontal propagation in the plane of the magnetic meridian. It is shown that each band has a low-frequency cutoff and that the existence of such a cutoff is a consequence of the boundary conditions rather than of attenuation. Numerical solutions of the dispersion equation are obtained for the two lowest bands for each of the conditions considered. (auth) (USGRDR)

52623 (ITSA-43) A COMPARISON OF SUDDEN IONOSPHERIC FREQUENCY DEVIATIONS WITH SOLAR X RAY AND CENTIMETER-WAVE EMISSION DURING OCTOBER 1963. Baker, Donald M. (Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Sept. 1967. 38p. GPO $0.30.

A simple model is developed which permits a calculation of the sudden ionospheric frequency deviation which would be caused by a known solar x-ray burst, or vice-versa, a calculation of the time profile of the x-ray burst responsible for an observed frequency deviation. This model is also used to compare the frequency deviations observed during six solar flares with the time profiles of the solar emissions at centimeter and x-ray wavelengths which accompanied the flares. Better time and spectral resolution are needed in order to permit a detailed comparison of the variations in the x-ray flux with the ionospherically induced frequency deviations. (auth)

52624 (N-68-21756) ALTITUDE DISTRIBUTIONS OF AND RADIATIONS FROM CERTAIN OXYGEN AND NITROGEN METASTABLE CONSTITUENTS. Ghosh, S. N.; Gupta, S. K. (Michigan Univ., Ann Arbor. High Altitude Engineering Lab.). Mar. 1968. Contract NASr-54(05). 24p. (NASA-CR-94130). CFSTI.

The airglow emitted by certain metastable constituents $N(^2D)$, $O(^1D)$, $O^+(^2P)$, and $O^+(^2D)$ in the daytime atmosphere is investigated and their altitude distributions are obtained. The production of $N(^2D)$ atoms by dissociative recombination of N_2^+ with electrons is considered. Their quenching by collisions with electrons and O_2 molecules is calculated, and it is shown that if quenching by electrons in neglected, the calculated integrated intensity of NI λ5199 line agrees with the observed value. Assuming collisional deactivation of $O(^1D)$ atoms by O_2 molecules, the production rates of $O(^1D)$ by photodissociation of O_2 in the Schumann–Runge continuum at low, medium, and high activities of the Sun are calculated. The $O(^1D)$ distribution and rates of emission of the oxygen red line in the dayglow are also calculated. Calculated intensity at minimum activity agrees with the observed value. The production rates of metastable $O^+(^2P)$ and $O^+(^2D)$ ions by photoionization of O atoms are calculated. Their equilibrium distributions are computed after using the recent data of rate coefficients for ion–atom interchange and other ionic reactions. (auth) (STAR)

52625 DISCUSSION OF PAPER BY Y. KONDO AND J. E. KUPPERIAN, JR., "INTERACTION OF THE NEUTRAL HYDROGEN AND CHARGED PARTICLES IN THE RADIATION BELTS: THE CONSEQUENT LYMAN-ALPHA EMISSION." Krassovsky, V. I. (Inst. of the Physics of the Atmosphere, Moscow). J. Geophys. Res., 73: 6402-3(Oct. 1, 1968).

Kondo and Kupperian reported that they have established that the Lyman-α atomic hydrogen emission has a clearly pronounced asymmetry with an intensity maximum in the direction of the geomagnetic pole. They believe that this radiation is due to excitation of atomic hydrogen in the lower parts of the radiation belts. This mechanism is challenged. A rebuttal by Kondo and Kupperian is given. (W.D.M.)

52626 MECHANISM OF TRANSMISSION OF HYDROMAGNETIC WAVES THROUGH THE EARTH'S LOWER IONOSPHERE. Altman, C.; Fijalkow, E. (Technion-Israel Inst. Tech., Haifa). Nature (London), 220: 53-5(Oct. 5, 1968).

Studies made since the report of elliptically polarized hydromagnetic waves in magnetic ground records at College, Alaska, and their propagation along geomagnetic field lines from the magnetosphere down to the Earth's surface, are reviewed, including data on micropulsations of the Earth's magnetic field in the frequency range 0.002 to 4.0 Hz. Summarizing these studies it is found that the correlation of micropulsations at geomagnetically conjugate stations requires a L wave to propagate between hemispheres; but the ground polarizations are not infrequently right-handed and the attenuation losses are generally characteristic of the R wave rather than the L wave. It has been suggested that an inter-mode coupling process in the ionosphere channels energy from the L to R modes. The purpose of the present communication is to present the results of a generalized analysis, and to clarify the mechanism of the coupling and transmission process. (UK)

52627 PRINCIPLE OF SOLAR WIND INDUCED PLANETARY DYNAMOS. Sonett, C. P.; Colburn, D. S. (Ames Research Center, Moffett Field, Calif.). Phys. Earth Planet. Interiors, 1: 326-46(Aug. 1968).

Planetary bodies free of both electrically insulating atmospheres and dynamo-driven intrinsic magnetic fields can support two identifiable magnetic field systems derived from sources in the solar wind. One is the result of spatial and time variations in the interplanetary magnetic field which appear time dependent in the comoving frame of the planet and is associated with the rotational part of the electric field system induced in the planetary body. The second consists of the quasi-captured steady-state interplanetary magnetic field. The latter can be shown to be consistent only with a curl-free electric field. The associated current system must close through the neighboring plasma of the solar wind and therefore constitutes a unipolar generator. The field lines have the general form that Gold depicted earlier for the Moon. The exact topology of the unipolar field depends upon the form of the closure through the solar wind. The strength of the unmodified unipolar electric field can be expressed in a form dependent upon the strength of the radial component of the interplanetary magnetic field and the angular velocity of the surface layer of the Sun. The potential field within the planet which is consistent with the unipolar current system is described by the fundamental equation $\sigma\nabla^2\phi + \nabla\sigma\cdot\nabla\phi = 0$, where σ is the bulk electrical conductivity and φ, the potential. For homogeneous σ this reduces to Laplace's equation guaranteeing the absence of free charge within the body. The more general case $\sigma = \sigma(r)$ corresponds to a real planet with radiative heat transfer to space and implies a complicated distribution of free charge. The partitioning of the flow field into the part captured by the planet and the part escaping to the limbs is discussed; the application to eventual limiting of the planetary current system is shown to lead to the formation of a shock wave while at the same time it limits the eventual size of the currents flowing in the interior. The results are discussed qualitatively in terms of the formation of a tail; other parts of the interaction can be categorized into magnetosphere, transition region, shock, and magnetopause but certain differences are apparent for the Earth. (auth)

52628 TYPE-B RED AURORA: THE O_2^+ FIRST NEGATIVE SYSTEM AND THE N_2 FIRST POSITIVE SYSTEM. Shemansky, Donald E. (Kitt Peak National Observatory, Tucson, Ariz.); Jones, A. Vallance. Planet. Space Sci., 16: 1115-30(Sept. 1968).

The O_2^+ first negative (1N) and N_2 first positive (1PG) systems were observed in type-B red aurora with a scanning spectrometer. The O_2^+ system was enhanced by a factor of between 2 and 3 relative to the N_2 1PG. The change in relative intensity of the two systems was comparable to the change in relative abundance of O_2 and N_2 from normal to type-B red auroral heights. The N_2 1PG displayed a gradual change in relative vibrational populations, as a function of auroral height. No evidence was found of an enhancement of this system in type-B aurora, contrary to previous published observations. The estimated total system intensities in IBC III type-B red aurora, determined from intensities relative to the N_2^+ Meinel system (I[M] = 2000 kR), are: $I[O_2^+1N] = 100$ kR, $I[N_2 1PG] = 2400$ kR. (auth) (UK)

52629 CALCULATED [O I] 6300 A NIGHTGLOW DOPPLER TEMPERATURES FOR SOLAR CYCLE MINIMUM. Roble, R. G.; Hays, P. B.; Nagy, A. F. (Univ. of Michigan, Ann Arbor). Planet. Space Sci., 16: 1109-13(Sept. 1968).

The effective Doppler temperatures of the nightglow [O I]6300 Å line are calculated using the data of Evans (1967) for electron density and ion temperature variations throughout the night during solar cycle minimum. These temperatures are shown to follow the exospheric temperature closely, but at a value of 25 to 50°K lower in most cases. (auth) (UK)

52630 TWILIGHT HELIUM EMISSION DURING LOW AND HIGH GEOMAGNETIC ACTIVITY. Shefov, N. N. (Inst. of the Physics of the Atmosphere, Moscow). Planet. Space Sci., 16: 1103-7(Sept. 1968).

Attention is drawn to the latest satellite data on the excess of helium in the upper atmosphere in the winter hemisphere. This effect is confirmed by seasonal variations of the intensity of twilight orthohelium emission at heights above 300 km. For the hydrogen H_α emission, testifying to the hydrogen content above 100 km, considerable seasonal variations are not shown. Thus the upper atmosphere bulge due to light atoms is displayed only at high altitudes. According to Jacchia (1967) and Keating (1967 and 1968), the helium bulge is due to a change in the atmospheric

composition in the mesopause region in winter time. Krassovsky (1966) believes that it is due to the transfer of light ions from the summer hemisphere to the winter hemisphere, with their subsequent neutralization. This transfer can be due to appropriate electric fields produced either by different fluxes of fresh photoelectrons or by systems of ionospheric winds in the summer and the winter hemisphere. Data are given on the behavior of the orthohelium emission during geomagnetic disturbances. (auth) (UK)

52631 GEOPHYSICAL PROCESSES AND COSMIC-RAY VARIATIONS AT THE TIME OF A MAGNETIC STORM AT VOSTOK STATION. Kazarin, V. A.; Kozin, I. D.; Taylor, D. H. Byull. Sov. Antarkt. Eksped., No. 63, 43-4(1967). (In Russian).

A magnetic storm began on August 29 at $20^h\ 30^m$ at the Vostok station, ending on September 4 at $16^h\ 30^m$. During the storm there was a considerable Forbush-type decrease in cosmic-ray intensity. Values of the H component of the geomagnetic field, cosmic-ray absorption at 20 megacycles, intensity of the neutron component of cosmic radiation, and deviation from the mean are tabulated for the 5 days of the storm. The results confirm the good negative correlation between the course of the H component and variations of the neutron component. (tr-auth)

52632 RADIO-STAR VISIBILITY FADES AND THE AURORA. Fremouw, Edward J. (Univ. of Alaska, College). Planet. Space Sci., 16: 1155-9(Sept. 1968).

Evidence is presented showing that vhf visibility fades at high latitude are a direct manifestation of the auroral disturbance phenomenon, at least at night near solar minimum. Photometers were employed to record auroral luminosity near the line of sight to a radio star. Auroral light was detected during all visibility fades that occurred under clear-sky conditions during six and one-half months of observation. A detailed discussion is given of an event that displayed particularly close relation between development of line-of-sight luminosity and measured changes in the structure of the scattered radio wave. (auth) (UK)

52633 RADAR THOMSON SCATTER OBSERVATIONS OF TEMPERATURE AND ION-NEUTRAL COLLISION FREQUENCY IN THE E REGION. Wand, R. H. (Cornell Univ., Ithaca, N. Y.); Perkins, F. W. J. Geophys. Res., 73: 6370-2(Oct. 1, 1968).

Values are reported of the ion temperature and the ion–neutral collision frequency in the altitude range 97 to 128 km deduced from radar Thomson backscatter measurements carried out at Arecibo where the radar wavelength λ is 70 cm. The measurements were performed by a double-pulse technique, which is required to obtain a height resolution of the order of the neutral atmosphere scale height. (W.D.M.)

52634 COMPARISON OF IONOSPHERIC ELECTRON CONTENT OBSERVATIONS AT DIFFERENT STATIONS. Rao, N. Narayana (Univ. of Illinois, Urbana); Klobuchar, John A. J. Geophys. Res., 73: 6373-8(Oct. 1, 1968).

In a recent paper (Rao and Yeh, 1968a), the Faraday and Doppler methods of obtaining ionospheric electron content from observations of orbiting satellite transmissions were compared. It was found that content variations obtained by differential Faraday and differential Doppler methods are consistent even during the passage of traveling disturbances, although there may be 5 to 10% discrepancies in the absolute values of content from the two methods. It is the purpose of this note to extend these results by comparing content variations obtained from overlapping passages observed at widely spaced stations (Urbana, Houghton, Bozeman, Hamilton, and Greenbank). (W.D.M.)

52635 SUBSIDIARY RESONANCES IN THE IONOSPHERE. Lewak, George J. (Univ. of California, San Diego, La Jolla). J. Geophys. Res., 73: 6379-83(Oct. 1, 1968).

Resonant responses observed by topside ionosondes in Alouette 2 have recently been examined [Barrington and Hartz, 1968]. Apart from the plasma normal mode resonances and their higher harmonics, other subsidiary resonances below the electron cyclotron frequency are also observed. These "subharmonic" resonances appear at frequencies that seem to be fractions of the normal mode frequencies of the plasma. This paper is concerned with a preliminary theoretical investigation of the possibility of such resonances at fractions of the plasma frequency only. This seems to be the simplest and best-documented case for a first theoretical investigation. (W.D.M.)

52636 EQUATORIAL VLF HISS AND INTENSE FLUXES OF SOFT ELECTRONS. Knudsen, W. C. (Lockheed Research Lab., Palo Alto, Calif.). J. Geophys. Res., 73: 6384-6(Oct. 1, 1968).

Absence of reports of intense electron fluxes with the energy of a few keV at low L values and low altitude led Gurnett to question some of the generation mechanisms requiring intense fluxes of electrons. It is suggested here that the good correlation of vlf hiss with intense fluxes of electrons can be extended to the equatorial zone. (W.D.M.)

52637 DISCUSSION OF PAPER BY B. A. WHALEN AND I. B. McDIARMID, "DIRECT MEASUREMENT OF AURORAL ALPHA PARTICLES". Reasoner, David L. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 6387-8(Oct. 1, 1968).

Whalen and McDiarmid speculated that the acceleration process is more efficient for alpha particles than for protons, and they suggested that a mechanism involving electric fields satisfies this requirement. Leaving aside the uncertainty in the auroral α/p ratio measurements due to uncertain corrections for charge exchange, it is the author's contention that if an electric field acceleration mechanism is assumed, then to investigate possible solar wind origin of auroral ions the quantity to be compared with the solar-wind α/p density ratio is the ratio of auroral alpha particles and protons at the same energy per unit charge rather than at the same energy, as Whalen and McDiarmid have done. A reply by Whalen and McDiarmid is included. (W.D.M.)

52638 DISCUSSION OF PAPER BY N. F. NESS, K. G. BEHANNON, C. S. SCEARCE, AND S. K. CANTARANO, "EARLY RESULTS FROM THE MAGNETIC FIELD EXPERIMENT ON LUNAR EXPLORER 35". Dolginov, Sh. Sh. (IZMIRAN, Moscow). J. Geophys. Res., 73: 6389-90(Oct. 1, 1968).

A comparison of absolute values of the magnetic field measured in the vicinity of the Moon by the satellites Luna 10 and Explorer 35 reveals an appreciable difference. It is concluded that, in all probability, this difference is mainly caused by an error in defining the longitudinal (with respect to the axis of satellite rotation) component of the field B_{11} in the experiment on Luna 10. In a reply by Ness he argues this point. (W.D.M.)

52639 DISCUSSION OF PAPER BY B. N. MAEHLUM AND B. J. O'BRIEN, "THE MUTUAL EFFECT OF PRECIPITATED AURORAL ELECTRONS AND THE AURORAL ELECTROJET". Brown, R. R. (Univ. of California, Berkeley); Barcus, J. R. J. Geophys. Res., 73: 6392-4(Oct. 1, 1968).

Maehlum and O'Brien proposed a mechanism to produce significant time variations in an initially time–stationary electron precipitation event. Essentially, it involved a cyclic modulation of the pitch-angle distribution of precipitated electrons by the geomagnetic variations from the auroral electrojet whose ionization is largely produced by the precipitating electrons in the energy range 1 to 10 keV. Model calculations using this atmospheric "feed-back" approach yielded periodicities in the range found for auroral electron precipitation events at energies greater than 20 keV. In this connection, the present comments are offered with the aim of clarifying certain features of the various forms of pulsating electron precipitation at auroral latitudes; from this discussion, there follow some points bearing on the relevance of the mechanism proposed by Maehlum and O'Brien. A reply by Maehlum and O'Brien is appended. (W.D.M.)

52640 DISCUSSION OF PAPER BY VICTOR GILINSKY AND GLENN PEEBLES, "THE DEVELOPMENT OF A RADIO SIGNAL FROM A NUCLEAR EXPLOSION IN THE ATMOSPHERE". Clapp, Roger E. (Basic Research Associates, Cambridge, Mass.). J. Geophys. Res., 73: 6395-6401(Oct. 1, 1968).

The question is asked whether the calculation described by Gilinsky and Peebles satisfies the requirements of causality. If this calculation is noncausal, then it will lead to nonphysical solutions of Maxwell's equations and will not give an accurate description of a process that can actually occur physically. A short comment by Peebles is attached. (W.D.M.)

52641 ANOMALOUS RESISTIVITY ALONG LINES OF FORCE IN THE MAGNETOSPHERE. Ossakow, Sidney L. (Lockheed Research Lab., Palo Alto, Calif.). J. Geophys. Res., 73: 6366-9 (Oct. 1, 1968).

The analysis presented here, based on the Whistler electron concentration data (Carpenter, 1966) and the more quantitative theory of Field and Fried (1964) and Fried and Ossakow (1966) reveals that the anomalous resistivity (due to unstable longitudinal ion waves), where $T_e \gg T_i$ is not expected beyond the plasmapause and is even marginal in regions within the plasmapause above the ionosphere. (W.D.M.)

52642 LONG-PERIOD WAVES GENERATED IN THE POLAR IONOSPHERE DURING THE ONSET OF MAGNETIC STORMS. Thome, George (Cornell Univ., Ithaca, N. Y.). J. Geophys. Res., 73: 6319-36(Oct. 1, 1968).

Large-scale trains of traveling waves observed at Puerto Rico during the onset of three magnetic storms are described. The vertical wave structure is examined between 100- and 800-km altitude with a range resolution of 37.5 km during the day and 75 km at night. The wave period ranges from 2 to 4 hours. Hor-

izontal phase velocity measurements were made during the wave train of highest amplitude. The speed of the first observed cycle was 700 m/sec and that of the last (11 hours later) was 125 m/sec. In both cases the direction of propagation was approximately north to south. The velocity of intermediate cycles could not be determined. Speeds of the order of 125 m/sec are typical for partially ducted gravity waves of long period, and the low speed cycles of the wave train are possibly of this type. Speeds of 700 m/sec, however, are too great to be explained in this way. It is suggested that the high-speed portion of the wave train represents energy propagated in a fully ducted mode that exists along the base of the thermosphere. A simple 2-layer model of the neutral atmosphere is used to compute the vertical structure of such a wave and the corresponding electron concentration perturbation. A quantitative comparison is made with the observations, and good agreement is found. It is concluded that the observed waves are atmospheric gravity waves powered by energy deposited in the auroral atmosphere during magnetic storms. (auth)

52643 OBSERVED FINE STRUCTURE OF A PHASE PERTURBATION INDUCED DURING TRANSAURORAL PROPAGATION. Porcello, L. J. (Univ. of Michigan, Ann Arbor); Hughes, L. R. J. Geophys. Res., 73: 6337-46(Oct. 1, 1968).

A radio wave experiences a phase perturbation as one first-order effect of propagating along a line-of-sight path that passes through an auroral form. If the line-of-sight path scans the aurora, the temporal behavior of the phase fluctuation provides some insight into the spatial distribution of the auroral ionization. The differential Doppler technique was used to estimate, with fine time resolution, the change in integrated electron density (IED) along a satellite-to-Earth propagation path that traversed a fairly intense auroral form. An independent determination of differential phase was made for each 30 meters of satellite travel at a satellite altitude of 1100 km. The gross increase in IED was of the order of 1 to 2×10^{17} m^{-2}; the quiescent IED at the time of observation was estimated to be 1 to 2×10^{16} m^{-2}. The time spectrum of the differential phase fluctuation $\psi(t)$ induced by the scan of the aurora could be well approximated by the form $S_\psi(f_t) = Af_t^{-n}$, at least over the frequency interval $0.1 < f_t < 10$ cps, where A is a constant and n is approximately 2.8. The characteristic slope n demonstrated little change from the most intense portion of the visible aurora to a near-quiescent region, although the level A changed by three orders of magnitude. Under certain restrictive assumptions $S_\psi(f_t)$ provides some insight into the nature of the IED spatial spectrum $S_{IED}(f_x)$. (auth)

52644 NIGHTTIME COOLING OF THE PROTONOSPHERE. Nagy, Andrew F.; Bauer, Pierre; Fontheim, Ernest G. (Univ. of Michigan, Ann Arbor). J. Geophys. Res., 73: 6259-74(Oct. 1, 1968).

This work is a theoretical study of the time-dependent nighttime behavior of the protonosphere. The coupled continuity momentum and heat equations were solved to obtain the time-dependent temperature and density profiles along two midlatitude geomagnetic field lines from an altitude of 1000 km in one hemisphere to the same altitude in the conjugate hemisphere. Energy and particle fluxes are also deduced from the numerical solution. The total energy conducted down from the protonosphere is sufficient to maintain the electron temperatures above that of the neutrals in the upper F region. The 40° geomagnetic latitude field line is characterized by an initial downward flux of ionization followed by an upward flux during the latter part of the night. The flux along the 50° field line is downward during the entire night with the magnitude of the flux slowly decreasing to zero. The calculated results are also compared with the few experimental data that are available. (auth)

52645 F2-REGION ELECTRON CONCENTRATION ENHANCEMENTS FROM INNER RADIATION BELT PARTICLES. Knudsen, William C.; Sharp, Gerald W. (Lockheed Research Lab., Palo Alto, Calif.). J. Geophys. Res., 73: 6275-83(Oct. 1, 1968).

Existence of electron concentration enhancements over the South Pacific and Africa at small L values is established from satellite data. In the fall of 1963, at a local time of 0130, and at an altitude of 300 km, the concentration at the center of the South Pacific enhancement was approximately 3×10^5 cm^{-3} greater than the base level. The enhancement is relatively stable and does not appear to be restricted in local time. The power input required to maintain the enhancement is estimated at 10^{17} ergs/sec, a value that is a few tenths the input in the auroral zones. Inner radiation belt electrons with energy in the range from a few tens eV to a few keV are the suggested source of ionization. A second region of enhanced electron concentration, which is stronger but apparently less geographically stable than that in the South Pacific, extends from near the South Atlantic magnetic anomaly eastward to the eastern edge of Africa and is approximately symmetric about the magnetic equator. (auth)

52646 OBSERVATIONS OF POGO ION CHAMBER EXPERIMENT IN THE OUTER RADIATION ZONE. Anderson, H. R.; Hudson, P. D.; McCoy, J. E. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 6285-97(Oct. 1, 1968).

The ion chamber on OGO-C, D (POGO) measures the total ionization produced by radiation able to penetrate 0.2 g/cm^2 of iron ($E_p > 10$ MeV, $E_e > 1$ MeV). The boundary of the outer radiation zone is observed at invariant latitude of 67° to 70° at 423 to 1525 km altitude, and on at least 34% of passes a narrow spike of intensity is observed a few degrees below the boundary. The spikes are distributed uniformly in local time, but correlate strongly with Kp. Spikes above the boundary occur preferentially on the dawn side. When perigee fell in the outer zone, the point conjugate to the observation point was below 100-km altitude at longitudes 300° to 50° E. During the period of March 22 through April 1, 1966, the ionization was very high at such points. This is interpreted as being due to intense injection of 1 to 10 MeV electrons at $\Lambda = 57°$ to 62°, and it is deduced that this is different from the lower injection that repopulates the outer zone in about half a longitudinal drift period. (auth)

52647 CONSERVATION EQUATIONS FOR WEAKLY TURBULENT PLASMAS. Abraham-Shrauner, Barbara (Ames Research Center, Moffett Field, Calif.). J. Geophys. Res., 73: 6299-6306(Oct. 1, 1968).

Conservation equations are derived for a weakly turbulent plasma in the quasi-linear approximation. The results are a generalization of Tidman's to include magnetic fields. The usual conservation equations are modified by extra terms, due to fluctuating fields, in the energy density of the electromagnetic field, the Maxwell stress tensor, and the Poynting vector. The steady-state conservation equations disagree with those of Kennel and Sagdeev for a shock wave in high-β plasmas. They keep the time-dependent terms arising from the fluctuating fields that vanish in the steady state assumed for a shock wave. (auth)

52648 POLARIZATION OF THE AURORAL ELECTROJET. DeWitt, Ronald N. (Univ. of Chicago). J. Geophys. Res., 73: 6307-11(Oct. 1, 1968).

The transient growth of an induced electric field is examined on the assumption that a primary electric field has been impressed along a band of aurorally enhanced conductivity in the ionosphere. The time constant for the growth is shown to be unimportant compared with the time scale of the auroral substorm, and the possibility that a certain class of auroral motions can be attributed to such a secondary or polarization electric field is discussed. (auth)

52649 EFFECTS OF ION-NEUTRAL COLLISIONS ON ION-ACOUSTIC INSTABILITIES IN THE AURORAL IONOSPHERE. D'Angelo, N. (European Space Research Inst., Rome). J. Geophys. Res., 73: 6313-18(Oct. 1, 1968).

The effect of ion–neutral atom (or molecule) collisions on the excitation of ion–acoustic instabilities in the auroral ionosphere is considered. These collisions may play an important role in selecting the wavelength of the perturbations that are most likely to grow at any given height. The results of the calculations are compared with observational evidence obtained from radio star scintillations and radar aurora echoes. (auth)

52650 OBSERVATIONS OF THE MAGNETOSHEATH–SOLAR WIND BOUNDARY. Burlaga, L. F.; Ogilvie, K. W. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 6167-78(Oct. 1, 1968).

By the use of data from the satellite Explorer 34, it is shown that discontinuous transitions between the magnetosheath and the interplanetary medium occur simultaneously in the proton spectrum, the flow direction, and the magnetic field intensity, during both geomagnetically quiet and disturbed times. A few boundary crossings were observed for which the plasma spectra appear to indicate a diffuse transition; a detailed study of an extreme example of such a crossing, based on simultaneous measurements of the spectra, the flow direction, and the magnetic field intensity, shows that the apparent diffuseness requires no new hypotheses for its explanation, but can be the result of motions of a bow shock. Observations of the velocity field in the neighborhood of the outer boundary of the magnetosheath are presented and are compared with results of the fluid theory, which predicts a standing shock. It is shown that, along the boundary on the flank of the magnetosheath, the ratios of the magnetosheath flow speed to the interplanetary flow speed are in close quantitative agreement with a prediction of the fluid theory, which is essentially independent of the Mach number and the adiabatic exponent. A highly directional flow is observed in the region $30° \lesssim \phi \lesssim 100°$, where ϕ is the Sun–Earth–satellite angle. The direction of this flow is consistent with the bow shock theory. (auth)

52651 SIMULTANEOUS MEASUREMENTS ON THREE SATELLITES AND THE OBSERVATION OF THE GEOMAGNETIC TAIL AT 1000 R_E. Fairfield, D. H. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 6179-87(Oct. 1, 1968).

During the last week of September 1966 the heliocentric orbiting spacecraft Pioneer 7 was behind the Earth in a position to observe the geomagnetic tail between 900 and 1050 R_E. At the same time Explorer 28 and Explorer 33 were monitoring the interplanetary medium and the magnetosheath near the Earth. Comparison of these simultaneous magnetic field measurements permits the isolation of intervals when Pioneer 7 is observing steady, enhanced-magnitude solar or antisolar directed fields characteristic of the extended geomagnetic tail. These fields are different from the interplanetary fields convecting past the other two spacecraft. The occurrence of approximately 10 intervals of tail observation of duration from a few minutes to several hours is interpreted as a sweeping of the tail across the spacecraft as the tail responds to variations in the direction of plasma flow. Discontinuous features in the interplanetary magnetic field are also found to convect past the three spacecraft with velocities that compare well with interplanetary solar wind velocities measured by the Vela satellites at the same time. Field magnitudes near the tail at 1000 R_E are found to be weaker than the corresponding interplanetary field as is predicted by the magnetogasdynamic theory. (auth)

52652 OBSERVED CORRELATIONS BETWEEN ELECTRON BURSTS IN THE MAGNETOTAIL AND ELECTRON PRECIPITATION IN THE AURORAL ZONE. Hones, E. W. Jr. (Los Alamos Scientific Lab., N. Mex.); Bame, S. J.; Singer, S.; Brown, R. R. J. Geophys. Res., 73: 6189-99(Oct. 1, 1968). (LA-DC-9518).

A series of balloon flights was conducted from College, Alaska, during August and September 1966 to study auroral-zone x rays. During several of these flights one of the Vela satellites, 3A or 3B, passed through the plasma sheet in the magnetotail near the midnight meridian. The Vela satellites carry Geiger counters sensitive to electrons of energy >45 keV and electrostatic analyzers that measure electrons and protons of energy between ~200 eV and ~20 keV. On six occasions a Vela satellite, at geocentric distance ~17 R_E, detected bursts of energetic electrons and/or variations of the plasma properties that were clearly related to x-ray bursts sensed concurrently by instruments on a balloon. There was a negative magnetic bay on the College magnetogram at the time of each of these events. The intensity-versus-time profile of the x rays observed at the balloon generally resembled the shape of the bay. That is, the x rays started and ended with the bay's beginning and end and, in several cases, reached maximum intensity near the time of the bay's peak. The plasma at the Vela satellite, however, behaved in quite a different manner. The plasma intensity decreased as the bay developed, then increased again during recovery of the bay. The plasma increases were evidently associated with the peaks of the bays because in each case the plasma increase started at about the time of, or following, the peak of the bay. In the three cases when Geiger counter data were available from the Vela satellite it showed that energetic electrons arrived at the satellite after x rays were detected by the balloon. These results support the view, reported earlier, that bays are associated with a contraction, or depletion, of the plasma sheet and that the auroral electrons derive their energy from processes occurring closer to the Earth than 17 R_E. (auth)

52653 FIELD-ALIGNED ELECTRON BURSTS AT HIGH LATITUDES OBSERVED BY OGO 4. Hoffman, R. A.; Evans, D. S. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 6201-14(Oct. 1, 1968).

In a series of passes in the northern high-latitude region, short bursts of radiation were observed in the energy range 0.7 to 24 keV by detectors aboard the polar orbiting satellite OGO 4. Among these bursts were a number in which the pitch-angle distributions at 2.3 keV displayed a maximum at small angles to the magnetic field lines. From the distributions and energy spectra it is argued that a possible source mechanism for these particles is electric fields parallel to the magnetic field lines at distances of several Earth radii. The source particles would then be the ambient thermal plasma, with two markedly different temperature components, one at a few eV, from which the field-aligned radiation originates, and the other greater than an order of magnitude hotter, which produces the isotropic portion of the pitch-angle distribution. (auth)

52654 ELECTRON CONCENTRATION VARIATIONS IN THE TOPSIDE IONOSPHERE BETWEEN 60°N AND 60°S GEOMAGNETIC LATITUDE ASSOCIATED WITH GEOMAGNETIC DISTURBANCES. Sato, Teruo (Ames Research Center, Moffett Field, Calif.). J. Geophys. Res., 73: 6225-41(Oct. 1, 1968).

Variations of electron concentration in the topside ionosphere associated with geomagnetic disturbances were analyzed between 60°N and 60°S geomagnetic latitude over the American continents, using Alouette 1 satellite data. Twenty individual storm-time variation profiles of electron concentration were derived. In low and equatorial latitudes two types of profiles, D and N, were observed. The D-type profile, which is composed of both enhancement and reduction parts, occurs in the daytime in the majority of cases, whereas the N type, characterized by enhancement, seems to occur mainly at night. In the midlatitudes no definite daytime and nighttime profiles were found, though an enhancement was observed most often at 25° to 35° geomagnetic latitudes, and a reduction was observed at 45° to 55°. Relationships between latitudinal and height extents, magnitudes of the storm-time variation of the electron concentration, Kp index, and season were not clear in this analysis. A qualitative explanation was attempted for these results, based on electron drift due to electromagnetic forces and ambipolar diffusion. This explanation seems to be applicable at least at low and equatorial latitudes. (auth)

52655 ROCKET ELECTRON CONCENTRATION MEASUREMENTS ON WINTER DAYS OF NORMAL AND ANOMALOUS ABSORPTION. Mechtly, E. A.; Shirke, J. S. (Univ. of Illinois, Urbana). J. Geophys. Res., 73: 6243-7(Oct. 1, 1968).

Lower ionosphere electron concentration profiles from rocket measurements are compared from a normal winter day, December 15, 1965, and from a winter day of anomalous absorption, January 19, 1966. Enhancements of electron concentration are found on the anomalous day relative to the normal day, from 60 to 95 km altitude, ranging up to a factor of 47 at 85 km. These enhancements in electron concentration are shown to be the direct cause of the increased absorption; although the electron collision frequency increased by a small amount, its contribution is relatively insignificant. The rocket measurements are shown to be consistent with measurements of electron concentration and absorption from sweep-frequency and fixed-frequency ionosondes. (auth)

52656 DENSITY AND TEMPERATURE FLUCTUATIONS IN THE DAYTIME F REGION OF THE IONOSPHERE. Doupnik, Joe Robert. University Park, Pa., Pennsylvania State Univ., 1967. 162p.

Thesis.

Large-amplitude electron density and temperature fluctuations in the daytime F region were observed at Puerto Rico during incoherent backscatter experiments on quiet days. Duration of the fluctuations was typically from one to four hours. They occurred between 180 km and at least 700 km and had amplitudes as large as 100-. They were strongest at the latitudes of Puerto Rico and much weaker to the north and south. During the fluctuations, the electron densities were observed to change inversely to the electron temperatures. Mechanisms for causing the fluctuations were investigated by examining electron density and temperature instabilities, variations of solar ionizing radiation, motions of the neutral atmosphere in the forms of gravity waves and winds, electrodynamic drifts associated with the dynamo current system, local drifting irregularities, and large traveling disturbances. Model computations of separate density and temperature profiles indicated that instabilities of the coupled density-temperature system were not responsible for these fluctuations. Local drifting irregularities and solar flux variations were shown to be not responsible by data from a network of spaced ionosondes. Electrodynamic drifts associated with the dynamo current system were shown to be at variance with vertical transport velocities computed from the experimental backscatter data. Data on one day indicated possible internal gravity wave induced fluctuations, but other fluctuations could be explained by a low latitude system of neutral winds. However, there are large differences between the required winds and current global wind models. (Diss. Abstr.)

52657 OCCURRENCE OF THE WINTER ANOMALY IN IONOSPHERIC ABSORPTION OF SHORT WAVES. Schwentek, H. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Nachrichtentech. Z., 21: 32-9(1968). (In German).

While the diurnal variation of ionospheric absorption shows fairly good correlation with the Sun's zenith angle, χ, the annual variation shows large deviations from this law in winter in middle latitudes. Also, the absorption for a constant solar zenith angle, being approximately the same in summer, shows large increases in winter. Referring to the normal variation of absorption with χ, or to the nearly constant value of absorption for cos $\chi = 0.25$, a winter anomaly value can be defined. This value varies widely from day to day; the median values, however, show a regular trend. The term winter anomaly is meaningless at equatorial and polar latitudes. At equatorial latitudes the annual variation of absorption is a function of the solar zenith angle only; towards high latitudes the winter anomaly can be found up to the northern polar circle. The occurrence of the winter anomaly

can be shown to be an effect of the large differences in the structure of the lower ionosphere (atmospheric density and temperature profiles) between summer and winter. (BBB)

52658 COMPARISONS BETWEEN NEW METHODS FOR ANALYSIS OF IONOSPHERIC RECORDS. Shilling, G. D. (Univ. of Kansas, Lawrence); Unz, H. Univ. Kans. Sci. Bull., 47: 735-60 (Feb. 15, 1968).

The uniform lamination analysis method was used to solve the simplified integral equation relating the electron density profiles in the ionosphere with the average measured virtual heights, taking the wave refractive index as the kernel function. The arbitrary auxiliary function was taken as $\phi(f_N) = f_N$. The $\phi = \mu$ method though less accurate than the $\phi = f_N$ method, is especially suitable for hand calculations. The errors resulting from the analysis of ionospheric records were investigated by taking 4 different, monotonically increasing, assumed electron density profiles. Both methods in their present form are only applicable to monotonic profiles. The present method of using $h'_{av}(f)$ instead of $h'(f)$ can be criticized because of reducing the method's sensitivity to information derived from the ionosphere; however, the integrated effect might conceivably reduce the effect of local inhomogeneities in the ionosphere as well as the instruments' error in each particular measurement by taking integrated values. The present method concentrates on improving the computing speed and reducing the cost, while maintaining a reasonable accuracy. (BBB)

52659 CLEAR-AIR TURBULENCE AND SPORADIC E ACTIVITY. McKay, A. Ronald (Utah State Univ., Logan). Science, 162: 270(Oct. 11, 1968).

Pilots' reports of clear-air turbulence correlate inferentially with sporadic E activity observed by backscatter radar. A cursory survey was made of 19 reports of turbulence between 1 and 20 August 1964 over the western United States; all but three correlate with sporadic E patches. (auth)

52660 VARIATION IN GEOMAGNETIC FIELD. Maeda, Hiroshi (Kyoto Univ.). Space Sci. Rev., 8: 555-90(Sept. 1968).

Daily variations in the geomagnetic field (the DV fields) and associated phenomena in the upper atmosphere are reviewed. Topics considered include average morphology, generalized dynamo mechanism, ionospheric-wind dynamo, solar-wind dynamo, observed motions and currents, variabilities, and motor effects. (W.D.M.)

52661 IONOSPHERIC MEASURING PROBE. II. RETARDING POTENTIAL TRAP. Miyazaki, Shigeru; Mori, Hirotaka (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo, 15: No. 79, 69-80(Mar. 1968).

Basic ionospheric parameters for electron density, electron temperature, ion density, ion temperature, space potential, etc., have until now been measured by individual probe systems in use with the space vehicles. However, it is necessary to measure all the ionospheric parameters at the same time by a single probe assembly especially for detailed comparison between the parameters or for measurement of the ion density when there are many ion species in the ionosphere. This paper describes the method of measuring the electron density, electron temperature, plasma space potential relative to vehicle potential, ion composition, and ion temperature at the same time by the use of Faraday-cup-type probe assembly. The probe system consists of two grids and a collector. The dc sweep voltage and the small amplitude of ac voltage are applied on one of the grids. The plasma parameters are analyzed from the dc and ac harmonics components. This method of measurement is considered for the purpose of obtaining all the ionospheric parameters self-consistently and accurately. (NSA of Japan)

52662 SOLAR ECLIPSES AND IONOSPHERIC THEORY. Rishbeth, H. (SRC, Ditton Park, Eng.). Space Sci. Rev., 8: 543-54(Sept. 1968).

Eclipse observations effects on contemporary theories of the ionospheric E and F regions are discussed; in particular, on the determination of production and loss rates, and on the role of diffusion and temperature changes. Various complicating factors that arise are discussed, but the paper is not intended as a comprehensive survey of results obtained. (auth)

52663 INVERSION PHENOMENON IN RADIO-STAR SCINTILLATION. Hooper, Andrew (Univ. of Adelaide). J. Atmos. Terrest. Phys., 30: 1823-6(Oct. 1968).

Some observations of the phenomenon known as "inversion" in records of scintillation of signals from the sources Cassiopeia A and Cygnus A are reviewed briefly. It is shown that the phenomenon is more likely to be explained by the finite angular diameters of these sources than, as suggested by previous authors, by the aperture size of the antenna used in making the observations. An experiment is suggested which should distinguish between these and other criteria which can bring about the observation of inversion. (auth) (UK)

52664 ANALYSIS OF THE TOPSIDE IONOSPHERIC DATA FROM ALOUETTE II OVER JAPAN. PART I. ELECTRON DENSITY DISTRIBUTION IN THE TOPSIDE IONOSPHERE OVER JAPAN. Ondoh, Tadanori; Matuura, Nobuo (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo, 15: No. 78, 59-68 (Mar. 1968).

Average height distributions of the electron density and geomagnetic field intensity at the vehicle are derived from Alouette II data in 35 orbits received at Kashima, Japan, during October 6, 1966, to February 9, 1967. The data used were mostly obtained in the nighttime because of limited commanding hours for Kashima. When a spike of the electron gyroresonance can not be identified on an ionogram, the electron density, N cm^{-3}, and geomagnetic field intensity, B gauss, at the vehicle are computed by new expressions, $N = 1.24 \times 10^4 f_x f_z$ and $B = (f_x - f_z)/2.8$, respectively, where f_x and f_z denote X-trace zero-range echo and Z-trace zero-range echo in MHz. Average height distributions of the electron density at the vehicle coincide very well with electron density profiles computed from the O- or X-mode traces. Scale heights of the average height distribution of electron density are larger at low latitudes than at middle and high latitudes at altitudes between 1000 and 3000 km. Latitudinal variations of the slope and the plasma temperature indicate that mainly ionic compositions at these height intervals may be H^+ at low latitudes and He^+ at middle latitudes. Moreover, it is found that the sudden decrease of electron density also exists at altitudes of ~1000 to 3000 km along the geomagnetic line of force starting from about 60°N in the geomagnetic latitude on the ground. (NSA of Japan)

52665 IONOSPHERIC MEASUREMENTS 1966. Schminder, R. Geophysikalische Messreihen des Geophysikalischen Observatoriums Collm. Karl-Marx-Universitaet, Leipzig, 1966. 141p. (In German and English).

Ionospheric drift measurements were performed with 3 transmitters in Czechoslovakia, East Germany, and Poland, and receivers at Collm. Recording is done with a 4-loop oscillograph with parallel observation of luminous tracks on a screen. Marking was by interruption at various short periods. Single recordings were for 30 min, for which an average drift velocity and direction was calculated by the similar fade method. Part of the drift recordings (15%) were subjected to full correlation analysis at each 22.7 min, giving 260 values at 5-sec intervals. Cross correlation functions, autocorrelation functions, and certain τ_s and τ_0 values are reported. Ionospheric conversion coefficients and ionospheric absorption measurements were performed with a transmitter at Kalundborg and receivers at Zittau and Koepenick. These parameters are reported as mean for the night hours, examples of the mean diurnal variations of absorption for each month and of seasonal variation are graphically illustrated. The altitude of reflection was assumed to be 90 km. (BBB)

52666 EMISSION OF VLF DURING THE GREAT DISTURBANCE OF 25-26 MAY 1967. Harang, L. (Norwegian Defence Research Establishment, Kjeller, Norway). Planet. Space Sci., 16: 1081-94(Sept. 1968).

During May 25-26, 1967, a violent disturbance appeared associated with great solar events of an unusual nature. A N-S chain of vlf recording stations (on 8 ko) was in operation covering geomagnetic latitudes $\Phi = 75$ to 50°. During the night 25-26 aurorae, appearing over middle Europe, started at about 23 UT. At the same time strong vlf emissions appeared at low-latitude stations, $\Phi = 62$ to 50°, with the greatest intensity at the most southern station. The appearance of vlf emission coincided with the start of a great Forbush decrease of 11% in the cosmic-ray intensity. The association of vlf emissions, Forbush decrease and SC of geomagnetic H with a solar flare of importance 3B is discussed, and speeds of clouds from the Sun of the order of 850 to 1000 km/sec are deduced. It is concluded that the vlf emissions were produced through interaction of the charged particles producing the Forbush decrease with the magnetospheric plasma in outer space. The amount of absorption suffered by the vlf waves when passing the disturbed ionosphere is discussed, and it is concluded that the initial energy of the emissions must have been above 10^{-11} W/m^2c. It is pointed out that great Forbush decreases are not always followed by recorded vlf emissions. (auth) (UK)

52667 SOME EFFECTS OF NEUTRAL AIR WINDS ON THE IONOSPHERIC F LAYER. Kohl, H.; King, J. W.; Eccles, D. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1733-44(Oct. 1968).

The ionospheric continuity equation for the F2 layer and the equation of motion of the neutral atmosphere were solved simultaneously to calculate diurnal variations of F2-layer critical fre-

quency and height at different latitudes for summer, equinox, and winter conditions. The agreement between the calculated and observed f_0F2 variations is reasonable for daytime conditions, but the night-time calculated values are generally too small. The anomalous F2-layer behavior observed at high latitudes in summer, and also the variation of the height of the layer peak at middle latitudes, appear to be satisfactorily explained by neutral air winds. These winds are also shown to be responsible for the evening enhancements observed at middle latitudes in summer. Relatively slight changes in the atmospheric model used in the calculations can result in very different diurnal variations of calculated critical frequency. (auth) (UK)

52668 THEORETICAL MODELS OF ELECTRON AND ION DENSITY IN THE NIGHTTIME D REGION. Radicella, S. M. (Univ. of Illinois, Urbana). J. Atmos. Terrest. Phys., 30: 1745-60(Oct. 1968).

The objective was to reproduce the characteristics of the experimental profiles available for conditions of middle latitude and low solar activity. The ionizing agents of the atmospheric gases below 90 km at night are considered to be galactic cosmic rays and precipitated electrons. It is shown that the ionization distribution is strongly dependent upon the concentration of atomic oxygen and ozone, and different theoretical models for these constituents were used in the computations. Four species of negative ions are considered to be important and, at all heights, those having high electron affinities are most abundant. It is shown that the reaction $O_3^- + N_2 \rightarrow NO_2^- + NO$ must be considered the main removal process for O_3 in order to obtain a reasonably good agreement between the computed and observed ionization profiles. (auth) (UK)

52669 ON THE ANALYSIS OF MOVING PATTERNS IN GEOPHYSICS. I. CORRELATION ANALYSIS. Briggs, B. H. (Univ. of Adelaide). J. Atmos. Terrest. Phys., 30: 1777-88(Oct. 1968).

The analysis of a moving random pattern is considered for the case where the whole pattern can be recorded. The pattern is assumed to have a certain mean velocity, and also to change randomly in form as it moves. It is shown how the velocity of movement, as well as parameters describing the spatial properties and the random changes, can be derived from two observations of the pattern separated by a known time interval. The determination of the velocity does not depend on the assumption that the spatial and temporal correlation functions have the same shape. If several observations of the pattern are made, separated by different time intervals, then the temporal correlation function of the random changes alone can be determined. The results should have applications to radio experiments using large aerial arrays for observations of ionospheric drifts, to photographic observations of moving patterns of light emission from the night sky, and to other similar phenomena. (auth) (UK)

52670 ON THE ANALYSIS OF MOVING PATTERNS IN GEOPHYSICS. II. DISPERSION ANALYSIS. Briggs, B. H. (Univ. of Adelaide). J. Atmos. Terrest. Phys., 30: 1789-94(Oct. 1968).

A method of analysis is described which enables the velocity of each spatial Fourier component of a two-dimensional pattern to be calculated from records of the pattern obtained at two times. From the results it is possible to determine whether the velocity is a function of the wavelength. This may be a useful method of analysis when it is suspected that dispersive wave motions play a part in the movements of the pattern. It should have applications to the study of ionospheric movements in experiments which use large arrays of aerials. The analysis may also have applications to other phenomena such as moving patterns of light emission from the night sky, observations of the form of the surface of the sea, and other geophysical phenomena in which moving patterns occur. (auth) (UK)

52671 MOVEMENT OF OFF-PATH IONOSPHERIC IRREGULARITIES DEDUCED FROM SHORT-PATH VLF MEASUREMENTS. Gossard, E. E.; Paulson, M. R. (Naval Electronics Lab. Center, San Diego, Calif.). J. Atmos. Terrest. Phys., 30: 1795-1807(Oct. 1968).

A short radio path was used to measure the spatial and temporal characteristics of fluctuations of vlf signals reflected from the ionosphere. The experiment used multiple-frequency transmissions from a horizontal vlf antenna received at a triangle of spaced receivers. Power spectrum and cross spectrum analyses of the phase and amplitude records were used to demonstrate that much of the fluctuation in the records results from Doppler beating of the principal signal and signal components reflected from off-path irregularities. A new technique for determining the position and movement of irregularities in the ionosphere is described for use when Doppler lines are an important part of the records. Some typical records are shown, and some implications concerning previous published analyses of fading records are discussed. The risk of interpreting periodic features in radio records as resulting necessarily from a wave structure in the ionosphere is made evident. (auth) (UK)

52672 DEPENDENCE OF DECLINATION CHANGE OF GEOMAGNETIC STORM SUDDEN COMMENCEMENT ON LOCAL TIME AND SEASON. Rao, V. Babu; Sastry, T. S.; Srivastava, B. J. (National Geophysical Research Inst., Hyderabad, India). J. Atmos. Terrest. Phys., 30: 1809-15(Oct. 1968).

The dependence of declination change at the time of geomagnetic storm sudden commencement on local time with seasons was investigated in the case of ten low- and middle-latitude observations. While at Alibag and Hermanus, and to some extent at Watheroo, the deviation angles of SC vectors, measured in the horizontal plane from the local magnetic meridian, show a systematic local-time variation with seasons, no such variation is observed at the other observatories. These results are examined in relation to the seasonal changes in the incident direction of the solar plasma stream responsible for SC's. (auth) (UK)

52673 HEIGHT DEPENDENCE OF THE EFFECT OF THE GEOMAGNETIC FIELD ON METEOR TRAINS. Watkins, C. D. (Royal Radar Establishment, Malvern, Eng.). J. Atmos. Terrest. Phys., 30: 1827-32(Oct. 1968).

It is shown that the Earth's magnetic field has a significant effect on meteor trains only at heights above about 92 km. This is consistent with theoretical predictions that the ambipolar diffusion coefficient in directions transverse to the geomagnetic field decreases above this height. (auth) (UK)

52674 RELATION BETWEEN GROUP PATH AND POLARIZATION ROTATION. Epstein, M. R. (Stanford Univ., Calif.). J. Atmos. Terrest. Phys., 30: 1833-6(Oct. 1968).

It is shown that, for one-hop oblique path propagation through a slowly varying ionosphere with no collisions, the rate of variation of incoming polarization with radio frequency is equal to one-half the group propagation time difference between the two magnetoionic components. This relation suggests that simple experimental techniques to measure the incoming wave polarization may provide the more difficult-to-measure differential group time information necessary for obtaining very accurate electron density profiles from oblique ionograms. (auth) (UK)

52675 WORLDWIDE MORPHOLOGY OF DAY-TO-DAY VARIABILITY OF S_q. Schlapp, D. M. (Univ. of Exeter. Eng.). J. Atmos. Terrest. Phys., 30: 1761-76(Oct. 1968).

The day-to-day variability of S_q was studied by using IGY data for a worldwide network of stations. Correlation coefficients for ranges in the horizontal component H at different pairs of stations were calculated. The correlation falls off rapidly with the distance of separation of the stations reaching 0.5 for separations of about 40° in longitude and about 15° in latitude. No significant difference was found between the behavior of electrojet stations and other tropical stations. It is suggested that these results make it seem likely that most of the day-to-day variability of S_q is due to variations in dynamo driving force rather than ionospheric conductivity. (auth) (UK)

52676 ACCELERATION OF TRAPPED PARTICLES THROUGH BIMODAL DIFFUSION IN AN INHOMOGENEOUS MAGNETIC FIELD. Theodoridis, George C. (American Science and Engineering, Inc., Cambridge, Mass.). Phys. Rev. Lett., 21: 1202-5 (Oct. 14, 1968).

Trapped particles can be accelerated or decelerated by diffusing at random in an inhomogeneous magnetic field via two or more diffusion modes that affect the particle energy differently. Acceleration through such "bimodal diffusion" can account for the high-energy particles trapped in the Earth's radiation belts. (auth)

52677 VARIATIONS IN ELECTRON PRODUCTION RATE IN THE IONOSPHERE. Velinov, P. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci., 21: 525-8(1968).

An expression for $\delta q/q$, the relative variation in time of the electron production rate in the ionosphere, has been obtained earlier and applied to the cosmic-ray layer (55 to 70 km) created by galactic cosmic rays. In this paper $\delta q/q$ is determined for the electromagnetic radiation (uv, x, etc.). (M.O.W.)

52678 PROPAGATION OF HYDROMAGNETIC WAVES IN CURRENT-CARRYING REGIONS OF THE IONOSPHERE AND MAGNETOSPHERE (PARALLEL PROPAGATION). Abbas, M. (Univ. of Rhode Island, Kingston); Poeverlein, H. Radio Sci., 3: 1010-19(Oct. 1968).

Propagation of hydromagnetic waves in the presence of a constant current density is investigated. The theory is developed from macroscopic equations in which a constant current density is introduced by assuming streaming velocities of the electron and ion fluids. The general dispersion relation is derived, and

approximate solutions of the dispersion relation are obtained for special situations. The special cases of this paper refer to a propagation vector in the direction of the magnetic field ("parallel propagation"). In parallel propagation, a transverse current density leaves the propagation vector unaffected, but causes a longitudinal electric field component and a consequent change of the ray direction. With the propagation vector and the current density in the magnetic field direction, the effect of currents is significant when J_0/H_0 is of the order of $k \simeq \omega/V_a$ (with $H_0 = B_0/\mu_0$ and V_a as the Alfvén velocity). When the quantity J_0/H_0 is larger than the wave number k, the current densities lead to a nonconvective instability. A numerical evaluation demonstrates the effect that currents in the ionosphere and magnetosphere may have on the waves. (auth)

Low-Temperature Physics

Refer also to abstracts 52182, 52868, 53040, and 53041.

52679 (AD-672357) LOW-TEMPERATURE PHYSICS RESEARCH. Final Report, June 16, 1959–June 15, 1968. Reynolds, Charles A. (Connecticut Univ., Storrs). June 16, 1968. Contract Nonr-2967(00). 25p. CFSTI.

Research on the following is summarized: superconducting properties and anisotropic electrical resistivities of pure and cadmium-doped tin; superconducting- and normal-state thermal conductivity of impure tin; energy gap and thermal conductivity of pure and impure superconducting tin; electrostatic effects and superconductivity in tiny samples; effect of the superconducting energy-gap anisotropy on the thermal conductivity of tin; the effect of antimony, indium, and zinc impurities on the critical-field curve of tin; anisotropy of the residual resistivity of tin with Sb, In, Zn, and Cd impurities, and the ideal resistivities and deviations from Matthiessen's rule at 77 and 273°K; measurement of the orientation of tin single crystals by optical means; depression of indium superconducting transition temperature by holmium and gadolinium. (USGRDR)

52680 ON THE THEORY OF VORTICES IN TYPE-II SUPERCONDUCTORS. van Vijfeijken, A. G. (Univ. of Amsterdam). Philips Res. Rep., Suppl., No. 8, 1-116(1968).

The theory of some properties of the mixed state of type-II superconductors is dealt with. First, vortices at rest are studied; the properties of isolated vortices are reviewed and an analysis of a system of interacting vortices is made. A new method to investigate the stability of the vortex lattice is given. Moreover, an expression for the electronic heat capacity in the mixed state is derived and a comparison with experiments is made. Further, an equation is derived which is the analogue of Bernoulli's equation for a classical frictionless fluid. Next, a macroscopic theory for the motion of vortices is developed. The two most important effects arising from the motion of vortices are the apparent electric resistivity and the Hall effect. As to the resistivity, it is found from the calculations that this quantity is essentially determined by the normal-state resistivity and by the volume fraction occupied by the normal vortex cores. A comparison with experiments shows that this theoretical result is in fair agreement with the data. For the Hall angle in the mixed state it is derived that this is the same as the Hall angle of the normal state at a magnetic field equal to the field present in the vortex cores. There is, however, a substantial disagreement between the theoretically predicted and experimentally observed Hall angles. Finally, a brief discussion of two similar theories for vortex motion, which have recently been put forward, is given. (auth)

52681 VIBRATIONAL MODES OF A NEGATIVE ION IN LIQUID HELIUM. Celli, V. (Univ. of Virginia, Charlottesville); Cohen, Morrel H.; Zuckerman, M. J. Phys. Rev., 173: 253-6 (Sept. 5, 1968).

A general expression is obtained for the breathing mode and the surface-distortion modes of a negative ion or electron bubble in liquid ^{4}He at low temperatures. The electron is assumed to be in a spherical potential well of finite depth. The modes are damped because of the excitation of compressional waves in the surrounding fluid. Numerical calculations indicate that the breathing mode gives rise to a broad resonance in the vicinity of 10^{11} sec^{-1} and that there is a rather sharp quadrupole distortion mode with frequency varying from 1.6×10^{11} to 5.6×10^{11} sec^{-1} as the external pressure varies from 0 to 20 atm. (auth)

52682 NEW SUPERCONDUCTORS. Alekseevskii, N. E. (Inst. of Physical Problems, Moscow). Usp. Fiz. Nauk, 95: 253-66(June 1968). (In Russian).

Some new types of superconductors, reported in the last three years, are briefly considered in the review. Among the pure metal superconductors are Ge and Si, converted into the superconducting state only under pressure, and protactinium, a new superconductor among the actinides. The superconductivity of thin films of some elements (W, Mo, Re, Al) was considered, and the reasons for the increase of their critical temperatures are examined. Since the number of superconductors among the alloys and compounds is very large, only some of these are examined. Compounds with the β-tungsten lattice type, among these the system Nb–Al–Ge, in which superconductivity is detected at 19 to 20°K, are among the compounds examined. Data are reported on the superconductivity of metastable compounds of Be, synthesized under pressure, and the superconductivity of Be alloys with high Be content is considered. The origin of superconductivity in laminated structures such as C_8M where M is one of the alkali metals is examined. Data are given on the superconductivity of tungsten bronze and halogenides. The results of studies of the superconductivity of clathrates, and particularly silver clathrate, are reported. (tr-auth)

52683 CORNER PARAMETERS FOR THE OSCILLATING DISK; CONSEQUENCES FOR LIQUID HELIUM II. Folse, R. F.; Hussey, R. G. (Louisiana State Univ., Baton Rouge). Phys. Fluids, 11: 2278-9(Oct. 1968).

Measurements of the period and logarithmic decrement of oscillating disks indicate that the inertial part of the corner parameter is zero. This result is used to correct the pile-of-disks measurements of the normal fluid density of liquid helium II. (auth)

52684 FIELD EMISSION FROM A SUPERCONDUCTOR. Leger, A. (Ecole Normale Superieure, Paris). J. Phys. (Paris), 29: 646-54(July 1968). (In French).

The field emission characteristics are calculated for a metal during the normal–superconductor phase transition. The current change is found to have a remarkable temperature dependence, it is not maximum at T = 0, and changes sign close to T_c. The emission current variation associated with the N–S phase transition at steady electric field is studied. The transition is modulated by applying an ac magnetic field and detecting synchronous ripples in the current. Although reproducibility is not good, the effect seems to exist. (auth)

52685 CRITICAL STATE EQUATION FOR SUPERCONDUCTING NIOBIUM WIRES. LeBlanc, M. A. R.; Chang, C. T. M. (Univ. of Southern California, Los Angeles). Solid State Commun., 6: 617-20(Sept. 1968).

Assuming $j_c = \alpha(1 - |B|/H_{c2})$, equations are easily obtained which accurately describe I_c vs. H for Nb wires in a simple arrangement simulating infinite slab geometry, and readily yield a measure of the pinning parameter α. (auth) (UK)

52686 EFFECT OF SMALL OSCILLATING FIELDS ON THE PEAK EFFECT IN TYPE-II SUPERCONDUCTORS. Chang, C. C.; McKinnon, J. B.; Rose-Innes, A. C. (Univ. of Manchester, Eng.). Solid State Commun., 6: 639-40(Sept. 1968).

It is shown that the peak effect in type-II superconductors may be greatly enhanced by applying a small oscillating magnetic field. There is experimental evidence that the "peak effect" is due to strong pinning of the fluxon lattice near H_{c2}. (auth) (UK)

52687 SUPERCONDUCTIVITY IN THE MONOCLINIC PHASE OF THE ALUMINUM–OSMIUM–RUTHENIUM SYSTEM. Mueller, J.; Heiniger, F.; Staudenmann, J.-L. (Univ., Geneva). Helv. Phys. Acta, 41: 1052-7(Oct. 20, 1968). (In French).

Monoclinic $Al_{13}Os_4$ is superconducting with a transition temperature $T_c = 5.5$°K. In the quasi-binary system $Al_{13}(Os_{1-x}Ru_x)_4$, substitution of Ru results in a single phase structure up to $x \sim 0.1$ with little change in T_c and complex superconducting behavior for $0.1 < x < 0.25$. The phase $Al_{13}Ru_4$, also monoclinic, shows no transition above 1.1°K. The coefficient of the electronic specific heat γ is 1.05 ± 0.05 mJ/mole °K^2 for $Al_{13}Os_4$, i.e., lower than that of pure aluminum, and 0.30 ± 0.02 mJ/mole °K^2 for $Al_{13}Ru_4$. Addition of iron to $Al_{13}Os_4$ depresses the transition temperature at a rate of 20°K per atomic percent. (auth)

52688 MECHANICAL EFFECTS IN TYPE II SUPERCONDUCTORS. Brandli, G.; Enck, F. D.; Fischer, E.; Olsen, J. L. (Swiss Federal Inst. of Tech., Zurich). Helv. Phys. Acta, 41: 706-10(Oct. 20, 1968).

Measurements of changes in magnetization curves under pressure and of magnetostriction in an alloy of indium with 14 at. % thallium are presented. Values for the stress dependence of the Ginzburg–Landau parameter are deduced. (auth)

52689 SUPERCONDUCTORS WITH MAGNETIC IMPURITIES IN A SINGLET GROUND STATE. Bucher, E.; Andres, K.; Maita, J. P.; Hull, G. W. Jr. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Helv. Phys. Acta, 41: 723-30(Oct. 20, 1968).

The effect of Pr and Tm doping on the superconductivity of Th

and of La compounds having the Cu_3Au structure is investigated. Although strongly paramagnetic, these alloys remain superconducting to high Pr and Tm concentrations due to the effect of crystal field splitting which produces a nonmagnetic, singlet ground state. The drop in the superconducting transition temperature is compared with the low-temperature van Vleck susceptibility and the crystal field splitting as derived from the Stark-type specific heat anomaly. Magnetic properties are also studied in the Th–Pr (fcc) system up to 90 at. % Pr. (auth)

52690 SUPERCONDUCTOR WITH CURRENT. **Straessler, Sigfrid (AG Brown, Boveri and Cie, Baden, Switzerland); Wyder, Peter. Helv. Phys. Acta, 41: 1221-5(Oct. 20, 1968). (In German).**

The effect of the mean free path l on a superconducting film carrying a current is calculated. It is found that at T = 0 the superconductor becomes gapless with the critical current for $l/\xi_0 = 15.78$, where ξ_0 is the BCS correlation length. The energy gap as a function of current and mean free path is evaluated numerically. (auth)

52691 THE $^3He/^4He$ DILUTION REFRIGERATOR. **Lounasmaa, O. V. (Technical Univ. of Helsinki). Helv. Phys. Acta, 41: 1021-8(Oct. 20, 1968).**

The principle of the $^3He/^4He$ dilution refrigerator is briefly discussed. Thermodynamic expressions are derived for the cooling capacity and for the ultimate temperature to be reached in a device of this novel type. (auth)

52692 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTORS. **Carruthers, Robert; Cornish, Donald Nelson (to United Kingdom Atomic Energy Authority). British Patent 1,128,972. Oct. 2, 1968. Filed Aug. 19, 1965.**

A method of testing a composite superconducting cable formed by a superconductor in intimate contact throughout its length with a normal conductor of high conductivity is described. This method comprises passing a current through a short length of the cable while it is immersed in a cryogenic coolant and subjected to a magnetic field of known magnitude, momentarily heating a small portion of the superconductor sufficiently to cause it to go normal and the current to transfer to the parallel normal conductor. The last step is repeated for increasing values of current until a value of current (the minimum propagating current) is reached at which on momentarily heating as aforesaid the normality of the superconductor propagates, and repeating all the steps for other known magnitudes of magnetic field. (M.H.R.)

52693 FINITE-GEOMETRY EFFECTS IN SYSTEMS WITH CONDENSATION AND A STUDY OF A VARIATIONAL-CANONICAL TRANSFORMATION APPROACH FOR INTERACTING BOSONS. **Krueger, David Allen. Seattle, Univ. of Washington, 1967. 189p.**

Thesis.

Two main topics are studied: (a) the effects of finite geometries and thermodynamic fluctuations on the existence of superconductivity and superfluidity and (b) the possibility of utilizing a variational principle and a canonical transformation to describe interacting Bose systems. Using the symmetry-breaking technique, it is shown quite generally that the quasi-averages usually associated with superfluidity and superconductivity vanish in partially finite geometries, i.e., where at least one dimension extends to infinity. Two possibilities for understanding this were investigated. First it was shown for the ideal Bose gas that even though condensation did not occur in partially finite geometries, many of the physical observables behave much as they do in the bulk system. This is because the partially finite systems have an ordered state with an exponentially long but finite range. This suggests that the usual characterization of superfluids and superconductors may be more restrictive than necessary. The second possible way to view the vanishing of the quasi averages in partially finite systems is to note that since some of the dimensions are extended to infinity, they may not be good approximations to the experimental systems. It was shown that an ideal gas in a strictly finite geometry can condense. The necessary and sufficient conditions on the size of the system such that condensation may occur are also given for the ideal Bose gas. Investigation of an ideal charged Bose gas showed that even though the system may exhibit off-diagonal long-range order (ODLRO), fluctuations can destroy any persistent current. Thus, ODLRO is not a sufficient condition for the existence of persistent currents. The study of the variational principle and canonical transformation approach for Bose systems is also divided into two parts. First, it is shown that, if the canonical transformation conserves the number of particles, the only singular second order phase transition describable by this method must have a critical chemical potential which is independent of temperature. Thus the method is not applicable to liquid helium. Secondly, a Bogolyubov-type model was studied at arbitrary temperatures and densities and was found to exhibit an energy gap in the elementary excitation spectrum contrary to a general theorem. (auth) (Diss. Abstr.)

52694 CRITICAL-REGION SECOND-SOUND DAMPING IN He II. **Tyson, J. A. (Univ. of Chicago). Phys. Rev. Lett., 21: 1235-7(Oct. 21, 1968).**

Second-sound attenuation very near T_λ is found to be proportional to the square of the frequency, and the damping diverges as $(T_\lambda - T)^{-\sigma}$, $\sigma = 0.34 \pm 0.06$, in agreement with dynamic scaling. The coefficient of the damping is consistent with recent estimates of the coherence length. (auth)

52695 EXPERIMENTAL THERMAL CONDUCTIVITY OF TWO DILUTE SOLUTIONS OF ^3He IN SUPERFLUID ^4He. **Abel, W. R.; Wheatley, J. C. (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett., 21: 1231-4(Oct. 21, 1968).**

Measurements are presented of the thermal conductivity at saturated vapor pressure of 1.3 and 5.0% dilute solutions of ^3He in superfluid ^4He over the approximate temperature range 0.035 to 0.5°K and of pure superfluid ^4He over the temperature range 0.04 to 0.16°K. Heat transport is primarily by ^4He phonons whose paths are limited by the ^3He quasiparticle–^4He phonon interaction and by boundary scattering, in qualitative agreement with a theory of thermal conduction in dilute solutions by Baym and Ebner. There is, however, quantitative disagreement with their calculation of the thermal conductivity for the above solutions. (auth)

52696 CRITICAL FLUCTUATION OF THE ORDER PARAMETER IN A SUPERCONDUCTOR+ I. **Maki, Kazumi (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 40: 193-200(Aug. 1968).**

The fluctuation of the order parameter in a superconductor in the temperature slightly above the transition temperature is studied in the framework of the current microscopic theory. It is convenient to divide the temperature region where the fluctuation of the order parameter becomes important into two regions; the classical and the critical region. In the classical region the spatial correlation of the fluctuation is of the Ornstein–Zernike type, while in the critical region it depends on the relative distance like $r^{-\frac{1}{2}}$. It is shown that the electrical resistivity, the nuclear spin lattice relaxation time, and the ultrasonic attenuation coefficient decrease like $1 - a|\eta|^{-\frac{1}{2}}$ and $1 - a'|\eta|^{-\frac{1}{2}}$ in the classical and in the critical region respectively, where $\eta = (T/T_c) - 1$ and a and a' are constants of the order $(T_c/\mu)^{\frac{1}{2}}(lp_0)^{-\frac{1}{2}}$ and $(T_c/\mu)^{\frac{1}{2}}(lp_0)^{-1}$, respectively. Here μ is the chemical potential, l is the electronic mean free path and p_0 is the Fermi momentum. It is also shown that the thermal conductivity has no singular term at the transition temperature. (auth)

52697 CURRENT DISTRIBUTION IN A THIN SUPERCONDUCTING STRIP. **Swan, G. W. (Mathematics Research Center, Madison, Wis.). J. Math. Phys. (N. Y.), 9: 1308-12(Aug. 1968).**

A mathematical model of the alternating-current distribution for a long superconducting strip with small thickness is analyzed. The interesting feature of the model is that it is soluble. The current distribution is found from the analytic solution to a singular integral equation, and from this solution it is possible to predict the behavior of the distribution throughout a complete cycle. Previous (unpublished) work showed that purely physical arguments did not give the correct predictions for this behavior at the end of each half-cycle. The present model overcomes this deficiency. (auth)

52698 FUNCTIONAL INTEGRALS FOR MANY-BOSON SYSTEMS. **Casher, A.; Lurie, D.; Revzen, M. (Technion-Israel Inst. of Tech., Haifa). J. Math. Phys. (N. Y.), 9: 1312-18(Aug. 1968).**

The grand canonical partition function (GCPF) is described for a system of interacting bosons as a functional integral over one complex function. The derivation is based on the so-called coherent-state representation [R. J. Glauber, Phys. Rev. 136, 2766 (1963)]. It is shown how to extract the perturbative expansion of the GCPF and the various Green's functions from the functional-integral representation and the relevance of the formalism to the theory of superfluidity is indicated. (auth)

52699 ENERGY-GAP ANISOTROPY IN SUPERCONDUCTING INDIUM. **Clark, T. D. (Mullard Research Labs., Salfords, Eng.). Phys. Lett., 27A: 608-9(Sept. 23, 1968).**

Structure identified with a local maximum of the energy gap surface in k space of In has been observed in the dV/dI versus V curves of Al–Al_2O_3–In tunnel junctions. (auth)

52700 SECOND SOUND IN ^3He–^4He SOLUTIONS. **Guyer, R. A.; McClintock, P. V. E.; Mueller, K. H. (Duke Univ., Durham, N. C.). Phys. Lett., 27A: 611-12(Sept. 23, 1968).**

The velocity of second sound in liquid ^3He–^4He solutions should exhibit anomalous behavior due to the attractive ^3He–^3He interaction. (auth)

52701 INFLUENCE OF A STATIC MAGNETIC FIELD ON ac LOSSES IN A TYPE-II SUPERCONDUCTOR. **Dammann, C.;**

Maldy, J.; Santamaria, E. (Centre de Recherches de la Compagnie Generale d'Electricite, Marcoussis, France). Phys. Lett., 27A: 631-2(Sept. 23, 1968).

In a sample of niobium carrying an alternating current, it is shown that the influence of a static magnetic field is almost essentially connected to the action of the dc field on the critical current. (auth)

52702 FLUCTUATIONS IN SUPERCONDUCTORS IN THE PRESENCE OF PARAMAGNETIC IMPURITIES. Schmidt, H. (Institut Max Von Laue–Paul Langevin, Garching, Ger.). Phys. Lett., 27A: 658-9(Oct. 7, 1968).

It is shown that the addition of paramagnetic impurities increase the singular part of the electrical conductivity above T_c, which is due to the fluctuations of the order parameter. (auth)

52703 THEORY OF THE DENSITY OF STATES OF TYPE-II SUPERCONDUCTORS. Brandt, U. (Univ., Hamburg). Phys. Lett., 27A: 645-6(Oct. 7, 1968).

The density of states in bulk type-II superconductors is calculated for magnetic inductions B below H_{c2} and all mean free paths. In the clean limit at the Fermi energy it behaves like $[(H_{c2}-B)/H_{c2}] \ln [(H_{c2}-B)/H_{c2}]$. The previous theory of the Green function and the density of states for clean type-II superconductors is generalized to include the effect of a finite mean free path l of the electrons. The vertex corrections due to the impurities can be calculated by a ladder graph approximation. Higher-order graphs lead to negligibly small corrections. (auth)

52704 QUANTUM INTERFERENCE MAGNETOMETRY AND THERMAL NOISE FROM A CONDUCTING ENVIRONMENT. Harding, J. T.; Zimmerman, J. E. (Philco-Ford Corp., Newport Beach, Calif.). Phys. Lett., 27A: 670-1(Oct. 7, 1968).

The response of a quantum interference magnetometer to magnetic Johnson noise from a conducting environment is discussed. A puzzling feature in the interpretation of a previously published experiment is shown to be incorrect. (auth)

52705 ANISOTROPY AND TEMPERATURE DEPENDENCE OF ULTRASONIC ATTENUATION IN THE MIXED STATE OF NIOBIUM. Gottlieb, M.; Garbuny, M.; Jones, C. K. (Westinghouse Research Labs., Pittsburg). Phys. Lett., 27A: 710-11 (Oct. 7, 1968).

Measurements of the ultrasonic attenuation near H_{c2} for pure niobium exhibit a dependence on magnetic field orientation and temperature which cannot be accounted for by current theories. (auth)

52706 MAGNETIC PROPERTIES OF SUPERCONDUCTING INDIUM–LEAD ALLOYS. Trojnar, E.; Makiej, B.; Sikora, A. (Inst. of Low Temperatures and Structural Research, Wroclaw). Acta Phys. Pol., 34: 311-17(Aug. 1968).

The magnetic moment of superconducting In–Pb alloys has been measured as a function of external magnetic field. The concentration and temperature dependence of the parameter has been derived from these measurements and compared with theoretical predictions. (auth)

52707 ION MOBILITY IN ^{3}He IN THE CRITICAL REGION. Achter, E. (Univ. of Chicago). Phys. Lett., 27A: 687-8(Oct. 7, 1968).

The decrease in ion mobility in liquid ^{3}He found near the critical point can be qualitatively explained as a consequence of the peak in compressibility near the critical point which causes an increase in the excess density around the ion due to electrostrictive forces. (auth)

52708 SECOND SOUND VELOCITIES IN He II NEAR T_λ. Johnson, D. L.; Crooks, M. J. (Univ. of British Columbia, Vancouver). Phys. Lett., 27A: 688-9(Oct. 7, 1968).

The velocity of second sound has been measured in He II at temperatures to within 40 μ degrees of the lambda transition. At temperatures within 150 μ degrees of the transition the velocity is found to be lower than that predicted by theory. (auth)

52709 SUPERCONDUCTIVITY OF CERIUM UNDER PRESSURE. Wittig, Joerg (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett., 21: 1250-2(Oct. 21, 1968).

Superconductivity has been detected in a high-pressure phase of cerium at pressures higher than 50 kbar. This is the first example of a pure metal which, in different crystallographic phases, shows both magnetic ordering and superconductivity. The important question again arises whether the "collapsed" α phase will become superconducting at a certain pressure. (auth)

52710 SIMPLE INTERPRETATION OF THE JOSEPHSON EFFECT. Bloch, F. (Stanford Univ., Calif.). Phys. Rev. Lett., 21: 1241-3(Oct. 21, 1968).

The effect of a dc voltage to cause an alternating current through the barrier between two superconducting regions was predicted on theoretical grounds by Josephson. It is shown for the simplified geometry of a thin ring, interrupted by a single barrier, that this effect can be interpreted as a direct consequence of general principles closely related to those previously employed to explain the quantization of trapped flux. (auth)

52711 NEW ABSORPTION PHENOMENON FOR TRANSVERSE ULTRASONIC PHONONS IN SUPERCONDUCTORS NEAR T_c. Leibowitz, J. R.; Fossheim, K. (Univ. of Maryland, College Park). Phys. Rev. Lett., 21: 1246-50(Oct. 21, 1968).

The absorption of transverse ultrasonic waves in superconductors shows peaks rising considerably above the normal-state attenuation level when the temperature is near that of the superconductor–normal phase transition, $H \neq 0$, and the phonon polarization $\vec{e}$ satisfies specific boundary conditions. The observations are found to be consistent with a model attributing the enhanced absorption to a loss mechanism associated with relaxation of the Ginzburg–Landau order parameter. (auth)

52712 EFFECT OF TEMPERATURE AND MAGNETIC FIELDS ON THE THIN-FILM dc SUPERCONDUCTING TRANSFORMER. Cladis, P. E. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 21: 1238-41(Oct. 21, 1968).

Magnetically coupled tin films are found to exhibit the characteristic dc transformer effect first reported by Giaever only for reduced temperatures of the primary $0.925 < t < 1$. A striking dependence of the secondary voltage on magnetic fields is also observed. The temperature dependence of the depinning current and the critical current is discussed. (auth)

52713 THERMAL CONDUCTIVITY OF He I NEAR THE SUPERFLUID TRANSITION. Ahlers, Guenter (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett., 21: 1159-62(Oct. 14, 1968).

The thermal conductivity of He I was measured at saturated vapor pressure from 10^{-7}°K to 5×10^{-3}°K above T_λ. The results agree in detail with dynamic scaling predictions and yield a critical exponent of 0.334 ± 0.005. The prediction is $\frac{1}{3}$. (auth)

52714 SIZE DEPENDENCE OF THE THERMAL CONDUCTIVITY OF HELIUM I NEAR THE λ POINT. Archibald, M.; Mochel, J. M.; Weaver, L. (Univ. of Illinois, Urbana). Contract SD-131. Phys. Rev. Lett., 21: 1156-8(Oct. 14, 1968).

The thermal conductivity of helium I was measured along its vapor-pressure curve over the range 3×10^{-6}°K $< T - T_\lambda < 1$°K using the parallel-plate technique. The exponent in a power-law variation of thermal diffusivity with $T - T_\lambda$ was found to depend on the plate spacing. These results could imply the existence of a relatively temperature-independent characteristic length in helium I near T_λ approximately 10^4 to 10^5 times larger than the coherence length. (auth)

52715 ROLE OF THERMAL PHONONS IN HIGH-TEMPERATURE SUPERCONDUCTIVITY. Appel, J. (Gulf General Atomic, Inc., San Diego, Calif.). Phys. Rev. Lett., 21: 1164-7(Oct. 14, 1968).

With Éliashberg's equations for the two-temperature Green's functions of a superconductor, the effect of real phonons on the transition temperature T_c is discussed. The equation derived for T_c/T_{c0} describes a temperature-dependent pair-breaking mechanism that depends on both the real and imaginary part of the electron–phonon self-energy (T_{c0} = transition temperature in the absence of real phonons). (auth)

52716 RESISTANCE MINIMUM IN TYPE-II SUPERCONDUCTORS. Axt, Carl J.; Joiner, W. C. H. (Univ. of Cincinnati). Phys. Rev. Lett., 21: 1168-72(Oct. 14, 1968).

A minimum in the superconducting flux-flow resistivity has been found in a $Pb_{60}Tl_{40}$ alloy and compared with a recent theory by J. R. Clem based on dissipation associated with temperature gradients across a moving fluxoid. The minimum disappears but the thermal dissipation remains significant in a $Pb_{95}Tl_{05}$ sample of longer electron mean free path. (auth)

52717 PROPERTIES OF SUPERCONDUCTING THIN TIN FILMS. Kobayashi, Haruo; Kunita, Masanori (Tohoku Univ., Sendai). Oyo Butsuri, 37: 821-6(Sept. 1968). (In Japanese).

Tin films of thickness ranging from 100 to 5000Å deposited onto liquid-nitrogen-cooled substrates of soda lime glass were found to be continuous even after warming to room temperature if the warming was done in the presence of dry oxygen at a pressure of 1 torr to avoid agglomeration. The electron-diffraction experiments showed that tin films less than 1000Å thick had a preferred orientation with C axis parallel to the substrate. The variation of the superconducting critical temperature T_{cf} of tin films with film thickness d was obtained by the relation $T_{cf} = T_{cb} + 0.04 + (2 \times 10^5)/d^{2.3}$, where T_{cb} is the critical temperature of bulk tin. The sharp increase of the critical temperature with

decreasing film thickness is interpreted to be due to the appearance of the preferred orientation in the films. (NSA of Japan)

52718 VARIATIONAL METHODS FOR THE GROUND STATE OF LIQUID ^{4}He. Schwager, Joerg (Univ., Tuebingen, Ger.). Z; Phys., 216: 411-32(1968).

Assuming a Bijl–Jastrow-type wave function for the ground state of liquid ^{4}He, one can express the energy as a functional of the pair distribution function g(r) when use is made of one of several "cluster approximations" known from the theory of classical fluids. The applicability of these approximations, and especially an integrodifferential equation for g(r) derived by Abe and Hiroike, are discussed. It is shown that both the HNC and PY approximations, when used consistently, yield the phonon behavior of the liquid-structure factor S(k) for small k. In the HNC approximation the energy as a function of density is calculated by a variational procedure. The velocity of sound following from $\lim_{k\to 0} S(k)$ is in good agreement with experiments and, at the equilibrium density, also with that calculated from the energy-versus-density curve. In the PY approximation a minimum of the energy expectation value does not exist without further restrictions on the trial wave function. (auth)

52719 THE ONSET OF SUPERCONDUCTIVITY IN THE TIME DEPENDENT GINZBURG–LANDAU THEORY. Schmidt, Hartwig (Institut Max von Laue, Garching, Ger.). Z. Phys., 216: 336-45(1968).

The fluctuations of the local order parameter above the superconducting transition temperature give rise to singularities in the electrical conductivity and the diamagnetic susceptibility. Using the time dependent Ginzburg–Landau equation the fluctuation of the current density is calculated. By means of the fluctuation–dissipation theorem and a dispersion relation the electromagnetic response function is then determined for small frequencies and wave numbers. The dynamical conductivity for bulk material, thin films, and thin wires shows an increasing peak at zero frequency the width of which decreases as the transition temperature is approached. This structure should be observable in microwave experiments. (auth)

Plasma and Thermonuclear Physics

52720 (AED-C-3-22) PLASMA PHYSICS INDEX. EXPERIMENTAL AND THEORETICAL PLASMA PHYSICS. Bibliography; Author Index; Subject Index. Volume 3, No. 7. Hilsenbeck, D. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 181p. Dep.

397 articles on various aspects of plasma physics are listed. Subject and author indexes are included. (M.O.W.)

52721 (CONF-671127) PROCEEDINGS OF INTERNATIONAL CONFERENCE ON PLASMA CONFINED IN OPEN-ENDED GEOMETRY, GATLINBURG, TENNESSEE, NOVEMBER 1–4, 1967. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 483p. Dep. CFSTI.

Separate abstracts were prepared for 14 of the 18 included papers. The remaining papers appeared previously in NSA as 22: 13429, 13515, 19932, and 36883. (M.O.W.)

For abstracts of individual papers see: 52723–52728, 52771, 52772, and 52826–52831.

52722 REVIEW OF RESEARCH ON HOT PLASMA PERFORMED AT THE DEPARTMENT OF PLASMA PHYSICS AND TECHNOLOGY OF THE INSTITUTE OF NUCLEAR RESEARCH. Gryzinski, Michal; Nowikowski, Jerzy; Sadowski, Marek; Suckewer, Szymon (Inst. of Nuclear Research, Warsaw). Nukleonika, 13: 719-52(1968).

The paper presents the main trends of research on hot plasma physics being carried out in the Institute of Nuclear Research at Swierk. The experimental arrangements as well as the diagnostic methods used and general technical problems are described. A review of theoretical studies is also given. (auth)

Confinement and Heating of Plasma

52723 (CONF-671127, pp 46-76) PLASMA CONTAINMENT IN DCX 1.5. Colchin, R. J.; Dunlap, J. L.; Postma, H. (Oak Ridge National Lab., Tenn.).

The DCX 1.5 device is a 20-keV H^+ injection machine employing the magnetic field and vacuum tank of DCX 1. The neutral hydrogen beam is Lorentz ionized in a 2:1 mirror trap which has a maximum central field strength of 14 kG. The plasma diameter is 12 inches and its length (FWHM) is approximately 1.25 inches. Hot ion densities above 10^8/cm^3 and lifetimes of 160 msecs have been attained. Three distinct and separable instability modes appear in DCX 1.5. One is called the Z mode because it is associated with axial current fluctuations. Its signals lie in frequency bands near $2\,\omega_{ci}$ and $3\,\omega_{ci}$. Ion losses due to this mode are negligible at presently attainable densities. The Θ mode is so named because it is associated with azimuthal gyrofrequency currents. Although it causes hot ion losses in a 10-kG central field, it is largely suppressed by a 13-kG field. The remaining instability is the flute. A "stable" or nongrowing flute is present at lower densities, becoming unstable with increasing plasma accumulation. "Stable" flute signals include several oscillation frequencies, the lowest of which has been observed to be density-dependent. An m = 1 unstable flute then evolves from these "stable" flute modes. When conducting endwalls are brought near the hot plasma, the unstable flute instability is suppressed. At higher magnetic fields only the Z mode remains, and the resulting plasma is charge-exchange-limited. (auth)

52724 (CONF-671127, pp 77-97) TARGET PLASMA EXPERIMENTS IN THE INTEREM FACILITY. Becker, M. C.; Blue, C. W.; Dandl, R. A.; Eason, H. O.; England, A. C.; Lazar, N. H.; Matlock, O. D.; McGuffin, M. W. (Oak Ridge National Lab., Tenn.).

Experiments in the INTEREM facility are the first in a series in which energetic neutrals are to be injected and trapped through charge exchange with cold ions in a target plasma produced by resonant electron cyclotron heating. In the experiments in INTEREM, the target plasma is produced by application of 20 to 40 kW of 10.6-Gc microwave power. The electron density in such a plasma ranges from 5×10^{10} to 5×10^{11} electrons/cc, depending on the ambient pressure environment and applied power. In the main electron group, $T_e \sim 120$ keV. The cold electron density is approximately equal to the hot density. A beam current of ~100 mA at 20 keV of H^+ is injected one Larmor radius off axis. At a pressure of 4×10^{-6} torr the accumulated energetic ion density is 5×10^8 ions/cm^3, $\omega_{pi}/\omega_{ci} = 1$. The behavior as a function of injected current and pressure is in accord with "classical" behavior, i.e., charge exchange limited. The increased density observed in comparison with gas trapping is also as expected from the atomic cross sections. No instabilities are observed. Because of the short plasma length (approximately 0.5 cm), ion electron loss-cone type instabilities are not expected. However, no evidence of the "double-hump" gyrofrequency modes expected at the higher harmonics are seen. The facility is being modified to incorporate the use of quadrupole coils to produce a minimum-B geometry. The "wall" mirror ratio will be 1.4:1 (r = 19 cm) while retaining the axial 2:1 mirror over a length of ±56 cm. Details of the new geometry are described. (auth)

52725 (CONF-671127, pp 144-69) PLASMA LOSSES IN THE MAGNETIC WELL OF DECA II. Brossier, P.; Lecoustey, P.; Renaud, C.; Tachon, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires).

For a regime in which the magnetic well is partially established before the plasma injection and with a plasma density of 10^{10} cm^{-3}, a wave at the ion cyclotron frequency and its harmonics were observed. (at $\omega = \Omega_{ci}$ it was found $k\rho i \geq 1$ and $\lambda_{11} \geq 14$ cm). The azimuthal structure of modes warps along the flux tube. Where the lines of force converge, the phase of the wave turns faster than where they diverge. The small amplitude of fluctuations (the electric field is about 1 V/cm) probably would explain that one does not see any losses connected with the instability. On the other hand, it was established that the plasma is mainly lost by charge exchange with a neutral gas compounded of both atomic and molecular deuterium, the pressure of which is up to one hundred times the base pressure. The study of the main energy sources which can create the instability and the experimental observations could support the identification of the wave with a double distribution cyclotron instability. (auth)

52726 (CONF-671127, pp 170-4) A CIRCULARIZED MAGNETIC WELL: DECA II B. Gaussorgues, J. P.; Lecoustey, P.; Tachon, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires).

The lifetime of the plasma is presently limited, in DECA II, by the charge exchange phenomenon on a neutral gas mainly created by an outgassing of the walls when the injected plasma following the lines of forces impinges on the walls. Modifications to produce a circular magnetic well are briefly described. (M.O.W.)

52727 (CONF-671127, pp 267-79) STUDIES OF OPEN-ENDED CONFINEMENT WITH ECR PLASMAS. Ard, W. B.; Dandl, R. A. (Oak Ridge National Lab., Tenn.).

Plasmas produced in magnetic mirrors by ECR are characterized by a very energetic electron component co-existing with a much less energetic background plasma produced by ionization of background neutrals. The densities and velocity distribu-

tion of the two components can be controlled to some extent. This property of ECR plasmas has made them very useful for the study of "line tying" stabilization of grad-B-driven drift modes. The presence of the two temperature components has allowed investigation of instability resulting from interaction of the two components, in particular an instability that results from a coupling of the hot component to waves in the cold plasma near harmonics of the electron-cyclotron frequency. This can be classed as a loss-cone driven instability, since it is driven by a positive slope in the energy distribution function of the energetic electrons. The result of the instability is a rapid spreading of transverse electron energies with those that lose transverse energy entering the loss cone of the mirror and being lost from the plasma. (auth)

52728 (CONF-671127, pp 280-308) CALCULATIONS OF PLASMA LOSS AND PLASMA POTENTIAL IN MIRROR MACHINES. Fisher, D. L.; McNamara, B.; Mason, D. W. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.).

Calculations by Fowler and Rankin of the steady state of plasma formed by injection of ions and electrons into mirror machines show that an economic mirror machine fusion reactor is unlikely to be feasible. The main simplifications of the model are neglect of the spatial dependence of the plasma potential and the dependence on angle in velocity space of the friction and diffusion processes. The earlier calculations of plasma loss and plasma potential are examined to show how acceptable are these simplifications. A new computer program has been written, based on the Fowler–Rankin model, to calculate the time dependence of ion and electron energy distributions and plasma potential. This program is useful in the study of actual experimental situations, and some examples of the influence on the loss of plasma of varying the mirror ratio, initial energy distributions, and injection rates are given. The new program has been used to check that an initially Maxwellian plasma with neutral injection does relax to the steady-state solutions found by Fowler and Rankin. The importance of the result for an economic mirror-machine reactor is reassessed. The conclusion is that such a reactor is feasible if (i) a way can be found of reducing the ambipolar potential (ii) a highly efficient means of injection can be devised and (iii) if stability does not limit the obtainable β to plasma densities giving uneconomic nuclear power densities. (auth)

52729 (IPP–2/67) MAGNETIC FIELD OF LEVITATED SUPERCONDUCTING QUADRUPOLE W VI. Rau, F. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1968. 20p. Dep.

Data are given of the up-to-now final choice of the configuration of the levitated superconducting quadrupole W VI. A summary is given of the plasma physics and technology used in developing the above configuration. (auth)

52730 (IPP–2/69) DETERMINATION OF THE MAGNETIC SURFACES IN THE STELLARATOR W Ib BY THE USE OF A PULSED ELECTRON BEAM. Berkl, E.; von Gierke, G.; Grieger, G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). June 1968. 42p. Dep.

By means of a pulsed electron beam the properties of the magnetic field of the stellarator W Ib were investigated, e.g., existence and shape of magnetic surfaces, rotational transform, shear. The existence of magnetic surfaces can be considered as proved with a certainty of 700:1. The experimental value of the rotational transform is 12% less than the calculated one, the shear is of interesting magnitude. (auth)

52731 (IPP–4/65) TECHNICAL EXPERIENCE WITH THE ISAR-I COLLECTOR. Breit, E.; Knobloch, A. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). June 1968. 11p. (CONF-680710–8). Dep.

From 5th Symposium on Fusion Technology, Oxford, England.

The collector arrangement of the linear theta pinch Isar I was described in Munich 1964. Since that time some experience has been gained with respect to operation, lifetime, and improvements added. The design principles are briefly reported. Whereas the precollectors have been in operation now over three years without damage, the highly stressed main collector and the coils have been subject to some failures and have been modified. Thirty-kV ringing duty shots (1.5 MJ) were used and in 1½ yr there were no breakdowns. When raising the energy to 2.7 MJ one gets the current-carrying sheets overstressed and has to increase the curvature radius at the coil feed edge. At the same time a collector extension was added and new coils shaped to minimize return flux distortion of the magnetic field symmetry in the coil. When operating the system with 1.5 MJ and crowbar — which had also been installed in the meantime — the copper sheets at certain places in the coil and extension region were hammered out of the feed slot. The extension and coils were exchanged for a solid steel version with welded copper contact bars which made possible the first 2.7-MJ crowbar shots. (auth)

52732 (UCRL–71010) LARGE SUPERCONDUCTING BASEBALL MAGNET. PART I. Henning, C. D.; Nelson, R. L.; Calderon, M. O.; Chargin, A. K.; Harvey, A. R. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 21, 1968. Contract W-7405-eng-48. 21p. (CONF-680813–3). Dep. CFSTI.

From Cryogenic Engineering Conference, Cleveland, Ohio.

A 1.2-m-diam-superconducting magnet is under construction as part of the Alice experiment in controlled thermonuclear fusion research. Shaped like the seam of a baseball, the magnet will produce a cusped magnetic field, close to 20 kG in the center, and up to 75 kG at the conductor. The superconductor, a ¼-in.-square composite of niobium–titanium with copper, will carry 2400 amperes during partially stable operation. Previously, large magnets have been conservatively designed for total nucleate-cooling stability. However, in this instance, space limitations have demanded a more severe stability requirement. Other novel features of this magnet include the ability to vary the shape of the magnetic field and the use of a new high-manganese stainless steel for the force restraining structure. (auth)

52733 EXPANSION OF A RESISTIVE SPHERICAL PLASMA IN A MAGNETIC FIELD. Bernstein, Ira B.; Fader, Walter J. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Fluids, 11: 2209-17(Oct. 1968).

The expansion of a resistive plasma into an external magnetic field has been treated in the limit in which the magnetic field does not perturb the plasma motion. The use of a class of exact solutions for the purely radial motion of the plasma in the absence of a field permits the reduction of the electromagnetic problem to consideration of a diffusion equation for the magnetic stream function. Explicit solutions are derived for a resistive spherical plasma expanding into a uniform applied magnetic field. Representative numerical results related to laser-produced plasma experiments of Haught and Polk are presented. (auth)

52734 PLASMA CONFINEMENT IN THE GENERAL ATOMIC TOROIDAL OCTOPOLE. Yoshikawa, Masaji; Ohkawa, Tihiro; Schupp, Arthur A. (Gulf General Atomic Inc., San Diego, Calif.). Phys. Fluids, 11: 2265-71(Oct, 1968).

Plasma confinement in the toroidal octopole device is described. The octopole field is produced by four current-carrying rings which are held in place by supporting rods. A toroidal field may also be applied. The plasma is injected from a coaxial gun. The density is variable from 10^9 cm^{-3} to 10^{11} cm^{-3} and the ion and electron temperature is approximately 100 and 6 eV, respectively. Measurements are performed by neutral and ion analyzers and by electrostatic and magnetic probes. The ion confinement time depends on the plasma density. At densities higher than 10^{11} cm^{-3}, the high-energy ions are lost in tens of microseconds by charge exchange interactions with the gas release by plasma bombardment near the injection window. At plasma densities below 10^{11} cm^{-3} the ion confinement time is several hundreds of microseconds at 100-eV ion energies. The decay is consistent with the loss to the supporting rods. The decay rate is at least an order of magnitude less than predicted from the Bohm diffusion coefficient. (auth)

52735 FLUX LOSS AND ENERGY BALANCE IN MAGNETIC FLUX-COMPRESSION EXPERIMENTS. Herlach, Fritz (Illinois Inst. of Tech., Chicago). J. Appl. Phys., 39: 5191-5204 (Oct, 1968).

A set of explosively driven flux-compression experiments with stainless steel liners and final fields in the range 2 to 6 MG is discussed. From experimentally determined field curves, the motion of the liner is derived by calculating the flux loss. Up to 80% of the initial flux is lost in these experiments. The variation of resistivity with temperature is taken into account, and the Joule heating energy is also determined. As can be verified by the energy balance, a consistent picture of the flux-compression process is obtained, including the phenomenon of field turnaround. The speed of sound in the liner material is comparable to the implosion speed; therefore, energy can be transferred to the magnetic field only from a thin inner layer of the liner. The energy accumulated in the magnetic field and in Joule heat increases very steeply at the end of the compression; thus, the inner layer of the liner is suddenly decelerated. There is still a large amount of kinetic energy in the outer layers of the liner at this instant. An empirical turnaround criterion is derived on the basis of these considerations. This shows that the peak field is practically independent of the initial field over a large range of initial fields. The final field depends essentially on the kinetic energy density of the liner. The influence of resistivity

on flux compression is also found to be small. Nevertheless, an upper limit for the resistivity of stainless steel in a megagauss field environment can be derived from the experiments. A value of 120 $\mu\Omega \cdot$ cm is found to be in best agreement with the experimental results. The methods developed in this paper can also be used to predict the performance of flux-compression devices. This is demonstrated with a few examples. (auth)

52736 EXPLOSIVELY DRIVEN HIGH-ENERGY GENERATORS. Crawford, J. C.; Damerow, R. A. (Sandia Lab., Albuquerque, N. Mex.). J. Appl. Phys., 39: 5224-31(Oct. 1968).

Design information, circuit analysis, and comparison of calculated and experimental results are presented for three different explosively driven current generators. These generators are all of the helical coil construction. The largest of these generators (9-in. diam) used 17 lb of high explosive to produce an output energy of 1.5 MJ. An exploding wire switching technique has been developed for use with these generators to produce output currents suitable for high-energy pulsed plasma experiments. The combination of explosive generator and switch has produced peak currents of 5 MA in 3 μsec and peak dI/dt values in excess of 4.0×10^{12} A/sec. (auth)

52737 CALCULATION OF A TUBULAR ELECTRON BEAM IN AXIAL-SYMMETRIC MAGNETIC MIRROR. Danilov, V. N. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 141-8(July-Aug. 1968). (In Russian).

An averaging method was previously used for calculations for helical beams in weak inhomogeneous fields. An attempt is made here to obtain an approximate solution for a tubular helical beam in a weak axial symmetric magnetic mirror, considering the field space charge. The solution was developed by a method of random approximations in relation to ϵ_*, the ratio of the characteristic width of the beam a_* to the characteristic dimension of inhomogeneous external fields L_* assuming that the beam is presented as two substreams with equal strength and vortex-free. The first approximation was obtained for the general case and the second for the approximation of beams with small and large space charge. (R.V.J.)

52738 PLASMA GENERATOR WITH BILATERAL OUTFLOW AND ELECTRODES OF VARIABLE DIAMETER. Zhidovich, A. I.; Kravchenko, S. K.; Yas'ko, O. I. Inzh.-Fiz. Zh., 15: 203-6(Aug. 1968). (In Russian).

A series of electric-arc gas heaters has been developed. The two main features of these heaters are: (1) they have two plasma-jet outlets in opposite directions, and (2) each of the electrodes is composed of two cylindrical parts having different diameters. The power of the heaters developed varies from 200 to 3000 kW. The heaters have the following advantages: (1) simplicity in construction, (2) long run time, (3) high voltage, and (4) they need not be connected to a stabilized-current power supply, but can be fed from a common constant-voltage direct-current energy source. With these advantages it is possible to simplify the whole system, thus making it cheaper and more efficient. (auth)

Diagnostics of Plasma

52739 (AD-672273) THEORY OF ELECTROSTATIC PROBES IN STRONG MAGNETIC FIELDS. Sanmartin, Juan R. L. (Colorado Univ., Boulder). May 1968. Contracts F33615-67-C-1850; DA-31-124-ARO(D)-139. 188p. (AFFDL-TR-67-190). CFSTI.

Thesis.

A theory is developed of an electrostatic probe in a fully-ionized plasma in the presence of a strong magnetic field. The ratio of electron Larmor radius to probe transverse dimension is assumed to be small, and an asymptotic perturbation method of multiple scales is used. The leading behavior of the solution is found. The results obtained appear to apply to weaker fields also, agreeing with the solutions known in the limit of no magnetic field. The range of potentials for which results are presented is limited. The basic effects produced by the field are a depletion of the plasma near the probe and a non-monotonic potential surrounding the probe. The ion saturation current is not changed but changes appear in both the floating potential V_f and the slope of the current-voltage diagram at V_f. The transition region extends beyond the space potential V_s, at which point the current is largely reduced. The diagram does not have an exponential form in this region as commonly assumed. There exists saturation in electron collection. The extent to which the plasma is disturbed is determined. A cylindrical probe has no solution because of a logarithmic singularity at infinity. Extensions of the theory are considered. (auth) (USGRDR)

52740 (IAE-1440) THE NATURE OF THE PROFILE ASYMMETRY OF H SPECTRUM LINES IN DENSE PLASMA. Sholin, G. V. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1967. 28p. (In Russian). Dep.

A systematic theory of profile asymmetry of H spectrum lines in dense plasma based on a quasi-static treatment of the ions and an impact treatment of the electrons is developed. It is shown that the principal reason for asymmetry is heterogeneity of the electric microfields, where quadrupolar interaction plays the main role, whereas the influence of the quadratic Stark effect, the corrections, linear with respect to the electric field of the ions ($E = e/R^2$), to the forces of the oscillators, the transition from the frequency scale to the wavelength scale and the multiplier ω^4 in the expression for the intensity of the components and the octuple interaction are effects of the following order with respect to the small parameter of the problem $\lambda = n^2 a_0/R$. Corrections of the quadratic interaction are very essential not only in the formulas for the energy of the Stark components but also in the expressions for their intensity. A qualitative interpretation is given of the experimentally observed asymmetry of the lines Ly-α and H_β, and calculated data are presented for the asymmetry of the Lyman, Balmer and Paschen lines. (JPRS)

52741 (LA-3968) HOLOGRAPHIC PLASMA DIAGNOSTICS. Jahoda, F. C. (Los Alamos Scientific Lab., N. Mex.). June 1968. Contract W-7405-eng-36. 9p. (CONF-680630-1). Dep. CFSTI.

From American Physical Society Meeting on Plasma Physics, Fluid Dynamics, Electron and Atomic Physics, Los Alamos, N. Mex.

The uses of holography in plasma diagnostics are reviewed. Holographic interferometry is the most significant technique. (auth)

52742 (NP-17568) SPECTROSCOPIC DETERMINATION OF THE DENSITY AND ELECTRONIC TEMPERATURE OF A HYDROGEN PLASMA. van Hauwermeiren, R. (Brussels Univ. (Belgium)). 1967. 225p. (In French). Dep.

Thesis.

A technique is developed for the measurement of N_e and T_e, which is simple and systematic. The method permits both these magnitudes to be determined from a single phenomenon and their evolution to be followed. The first part of the work is concerned with a synthesis of the theory on the basis of plasma spectroscopy; the theory is applied to the determination of T_e and N_e. A new method for the determination of the density is developed. The principle of the method consists in the simultaneous measurement of the intensity emitted in one line with two different channel lengths. The development and testing of the apparatus for putting the method into operation is described. The experimental results obtained are reported and discussed. (J.S.R.)

52743 NUMERICAL ANALYSIS OF A COAXIAL ACCELERATOR. Butler, T. D.; Cook, J. L. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 11: 2286-8(Oct. 1968).

The plasma distribution in a coaxial accelerator has been studied using a modified fluid dynamics computing technique. The findings lead to an alternative interpretation of the distribution than that deduced by Lovberg from schlieren photographs. (auth)

52744 MEASUREMENT OF WAVE NUMBER SPECTRA IN A PLASMA. Bousquet, J. C.; Parisot, M.; Perceval, F.; Perulli, M. (EURATOM-CEA, Fontenay-aux-Roses, France). J. Phys. (Paris), 29: 597-604(July 1968). (In French).

A method of analysis of the wave number spectrum in a plasma column is described. (auth)

52745 ABSOLUTE IMMERSION-TYPE ELECTRICAL PLASMA CONDUCTIVITY PROBE. Stubbe, Elie J. (National Research Council, Ottawa, Can.). Proc. IEEE (Inst. Elec. Electron Eng.), 56: 1483-93(Sept. 1968).

The feasibility of measuring the spatial distribution of the electrical conductivity in plasmas by means of an immersed plasma probe has been examined. By solving the Maxwell-Helmholtz equations for the case of a coil inside a cylinder immersed in an electrically conducting medium, the change in coil impedance due to the presence of the medium is predicted. The exact solution is numerical, but for certain limiting cases analytical and empirical design formulas are obtained. A bridge and phase-sensitive demodulator allows separation of the resistive and reactive signal components; experiments with electrolytes and with shock-tube plasmas show that the theoretical predictions are borne out in practice to a good degree of accuracy, thereby providing an absolute method for which no known electrical conductivity standards are required. The plasma cooling effect of the probe is considered and an estimate for corrections is suggested. (auth)

52746 DOPPLER EFFECT IN A WARM UNIAXIAL PLASMA. McKenzie, James F. (Ames Research Center, Moffett Field, Calif.). J. Inst. Math. Appl., 4: 250-69(Sept. 1968).

The character of the radiation emitted by a radiator moving with uniform velocity through a warm, uniaxial plasma is considered. It is shown that the dispersive and anisotropic nature of the plasma plays an important role in determining both the Doppler shift in frequency and the power spectrum of the radiation. The power spectrum and the Doppler relation between the frequency and the direction of the emitted radiation are calculated when (a) the motion is parallel to the magnetic field, and (b) the motion is perpendicular to the magnetic field. It is shown that the Doppler shift and the power spectrum are substantially different in these two cases. The formulae for the Cherenkov radiation emitted by a moving charged particle may be obtained from those for Doppler radiation. It is also shown that a particle moving parallel to the axis of symmetry excites a power spectrum which is linear with frequency, whereas a particle moving perpendicular to that axis excites a power spectrum that is sharply peaked near the plasma frequency. (auth) (UK)

52747 RADIO-FREQUENCY CHARACTERISTICS OF ELECTRODES IMMERSED IN MAGNETOPLASMA AND APPLICATION TO PLASMA DIAGNOSTIC TECHNIQUES. I. Miyazaki, Shigeru (Radio Research Lab., Tokyo). J. Radio Res. Lab., Tokyo, 15: No. 78, 81-103(Mar. 1968).

The basic equations for interaction between the magnetoplasma and the alternative electromagnetic field are reviewed. In the case of the cold plasma approximation, the radio-frequency characteristic of the infinite parallel plane electrodes is described over the frequency range including the ion and electron plasma frequency and cyclotron frequency. Next, the potential distribution around a single point charge is discussed, and it is concluded that there does not exist an inhibited region at all even in the so-called lossless hyperbolic condition. The radio-frequency characteristic of parallel wire electrodes is next studied. (NSA of Japan)

52748 DIAGNOSIS OF PLASMA BY THE MICROWAVE TECHNIQUE. Komura, Hirotsugu (Mitsubishi Electric Corp., Japan). Mitsubishi Denki Lab. Rep., 42: 1254-9(Sept. 1968). (In Japanese).

The electron density and gas temperature in a supersonic argon plasma flow have been measured by the microwave technique and also by using spectroscopically the relative line intensities. It has been found from the experiment that the electron recombination process is in a frozen state in the fully developed expansion region, but electrons diffuse out according to ambipolar diffusion to the wall of the supersonic nozzle; in the expansion process of plasma, electron disappearance by ambipolar diffusion is much more predominant than by three-body recombination. (NSA of Japan)

52749 DISTRIBUTION OF TEMPERATURE, VOLTAGE, AND ELECTRIC FIELD IN THE DC ARC PLASMA OF URANIUM MATRIX IN AIR UNDER ATMOSPHERIC PRESSURE. Avni, R. (Nuclear Research Centre, Beer-Sheba, Israel). Spectrochim. Acta, Part B, 23: 597-617(Sept. 1968).

The "axial" temperature of the dc arc with uranium matrix between graphite electrodes was investigated using the "two lines" method with Zn, Cu, and Fe. An axial gradient was found. Beginning at the anode the temperature rose towards the cathode, through an isothermal region in the center of the arc core. Core dimensions, measured with the aid of a cine-camera and densitometric measurements of its negative, are given. A new method for measuring voltage and electric field in the arc plasma was developed. The method consists of passing a "ladder" of tungsten wires through the plasma and measuring the voltage oscilloscopically. The axial voltage gradient, axial and radial electric field and plasma width were measured directly. A comparison of this method with the usual "$V_a + V_c + E_z \cdot l$" method was made. An empirical relation between the axial voltages and temperatures was developed. (auth) (UK)

52750 MEASUREMENT OF EXCITATION TEMPERATURES IN A HIGH-CURRENT HOLLOW CATHODE. Bueger, P. A.; Scheuermann, W. (National Physical Research Lab., Pretoria). Z. Phys., 216: 248-60(1968). (In German).

Measurements of excitation temperatures in the negative glow light of a high-current hollow cathode discharge lamp with a gas temperature of about 1500°K have shown values for T_a of approximately 5000°K, when the atomic spectral lines are used as indicator. However, from ionic lines a temperature of 30,000 to 100,000°K is deduced depending on the nature of the discharge gas. This big difference indicates that there is no Maxwell distribution in the hollow-cathode discharge. A possible explanation could be that two energetically distinct types of electrons take part in ionization and recombination, respectively. (auth)

52751 STATISTICAL PROCESSING OF THE SPECTRAL LINE CONTOUR AND POSSIBILITIES OF PLASMA DIAGNOSTICS. Terpugova, N. S. (Physical-Technical Inst., Tomsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 30-2(Feb. 1968). (In Russian).

At present, methods of plasma diagnostics based on spectral line contours are widely used. However, the existing methods do not make it possible to take advantage of the asymmetrically self-reversed lines, although they give very broad information on plasma. A method is proposed for the statistical processing of experimental contours which would permit the simultaneous evaluation of the following plasma parameters: temperature and concentration of electrons and atoms (ions) and degree of heterogeneity of the source. The method was developed on the basis of the N. G. Preobrazhenskii theory of the contour of spectral lines. A universal program for the processing of experimental contours on the UTSBM M-20 was composed. (tr-auth)

52752 DETERMINATION OF THE ELECTRON CONCENTRATION IN ARC DISCHARGE PLASMA. Milyus, A. V.; Tyasina, A. N.; Suzdalov, I. I.; Nazarov, T. V. (Yakutsk State Univ., USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 32-4(Feb. 1968). (In Russian).

An experimental investigation was made of the broadening of a series of spectral lines of the calcium atom: 4878.13, 4578.57, and 4425.67 Å. The contours of the spectral lines were calculated using the nonsteady-state theory for electrons. From the experimentally measured magnitude of the broadening of the lines, values of the electron concentration n_e in the arc plasma were obtained as a function of the plasma composition. (tr-auth)

52753 METHOD FOR CONTINUOUS DIAGNOSTICS OF THE ELECTRON CONCENTRATION OF PLASMA. Men'shikh, O. F. (Novosibirsk State Univ., USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 39-41(Feb. 1968). (In Russian).

The method reported has a high resolving power and a convenient form for the representation of the measured results and is based on the use of the superhigh-frequency system of automatic control. One of the variants of the construction of the system is proposed, and the conditions for its asymptotic stability are examined. The future uses of the high-speed system of self-regulation during use of different procedures of plasma diagnostics are indicated. (tr-auth)

52754 EFFECT OF THE ELECTRON DISTRIBUTION FUNCTION WITH RESPECT TO ENERGY ON THE FORM AND INTENSITY OF THE SPECTRAL LINES. Preobrazhenskii, N. G.; Tambovtsev, B. Z.; Shaparev, N. Ya. (Novosibirsk State Univ., USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 28-30(Feb. 1968). (In Russian).

A quantitative evaluation was made of the effect of the deviation of the electron distribution function from the Maxwellian distribution on the form and integral intensity of the lines. The cases of optically thin and optically dense plasmas were examined. For optically thin plasma layers, the non-Maxwellian distribution of the electrons with respect to energy changes the integral intensity of the lines and affects the Stark components; if the layer is optically opaque, then deformation of the source function occurs which indicates the degree of self-reversal of the contour. (tr-auth)

52755 DIAGNOSTICS OF STRONGLY HETEROGENEOUS SOURCES OF LOW-TEMPERATURE PLASMA BY ASYMMETRIC SELF-REVERSAL OF THE SPECTRAL LINES. Semenov, B. K.; Terpugova, N. S. (Physical-Technical Scientific Study Inst., Tomsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 20-2(Feb. 1968). (In Russian).

Experimental profiles were obtained of the nine asymmetrically self-reversed lines emitted by plasma jets of a low-voltage pulse discharge. As a result, the optical densities, Voigt parameters, displacements, and half-widths of the re-absorbed lines were evaluated. The electron density, both with respect to the displacement and with respect to the half-width of the re-absorbed lines, was determined. Both results agree within the limits of error. The population of some levels were also evaluated with respect to the optical density. The data obtained confirmed, that in the given source, the Boltzmann law was fulfilled for the distribution of atoms according to state. (tr-auth)

52756 INVESTIGATION OF THE COMPOSITION AND TEMPERATURE DISTRIBUTION OF THE ELECTRONS AND IONS ACROSS PLASMA JETS BEHIND SLITS OF PULSED ELECTROMAGNETIC ACCELERATORS. Ivanova, L. E. Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 22-5(Feb. 1968). (In Russian).

The distribution of electron temperatures in plasma of coaxial pulsed electromagnetic accelerators was investigated by spectral methods. The electron temperature inside the coaxial in the vicinity of the slit was 3×10^4 °K with voltages on the condenser

battery of 4 to 5 kV; the ion temperature under the same conditions was 4×10^4 °K. During passage through the shock wave, being formed at the slit near the inner electrode, the ion and electron temperatures increase and attain 8 to 9×10^4 and 4×10^4 °K, respectively. At distances of 25 cm from the slit $T_e = 1.7 \times 10^4$ °K and $T_i = 2 \times 10^4$ °K. (tr-auth)

52757 MEASUREMENT OF THE TEMPERATURE OF PULSE-DISCHARGE PLASMA IN DEUTERIUM BY SELF-REVERSED SPECTRAL LINES. Berezin, I. A.; Kuznetsov, F. O.; Model, I. Sh. Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 6-10(Feb. 1968). (In Russian).

The change of the temperature of deuterium plasma with the time of the high-power pulse discharge (W = 4.2 kJ) at pressures from 0.5- to 50-mm Hg was measured by the Bartel's method on self-reversed lines. The measurement was carried out with and without consideration of the forced radiation. The results are compared with the measurement of the temperature with respect to the continuum intensity. From the comparison of the results it is concluded that Bartel's method more accurately reproduces the qualitative picture of the time pattern of the temperature, rather than measurement by the continuum intensity. (tr-auth)

52758 MEASUREMENT OF THE THERMAL CONDUCTIVITY IN A MAGNETIC FIELD. Mahn, C.; Ringler, H.; Zankl, G. (Institut fuer Plasmaphysik, Munich). Phys. Lett., 27A: 683-4 (Oct. 7, 1968).

The thermal conductivity of a hydrogen plasma was measured in a transverse magnetic field in the temperature range between 10,000 and 50,000°K. (auth)

52759 ANALYSIS OF FIELD TEMPERATURE IN CYLINDRICALLY SYMMETRIC ELECTRIC ARC COLUMN. Asinovskii, E. I.; Pakhomov, E. P. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp., 6: 333-6(Mar.-Apr. 1968). (In Russian).

The temperature distribution of heavy particles (atoms and ions) in an electrical arc column in argon stabilized by a cold wall was determined, considering that the electron gas temperature distribution and electrical characteristics of the arc are known. The calculations were based on a two-liquid plasma model which can be applied to the arc at atmospheric pressure. It was found that an ambipolar electron and ion diffusion with recombination on the wall and the recombined energy transfer to the wall is the only mechanism which transfers the ϑ_e energy from the electron gas to the wall. The tabulated data indicated a certain temperature discontinuity in the electron and atom–ion gas near the wall reaching the temperature of 5000 to 8000°K. The temperature disruption is caused by different heat-exchange efficiency between corresponding plasma components and the wall under the conditions of arc discharge. (R.V.J.)

52760 QUASI-STATIC APPROXIMATE VALUE OF THE RESONANCE OF A CAPACITOR SYSTEM CONTAINING A WARM PLASMA. Poularikas, A. D. (Univ. of Rhode Island, Kingston). J. Appl. Phys., 39: 5328-9(Oct. 1968).

The approximate value of the resonance of a capacitor system is developed assuming that an inhomogeneous and warm plasma is contained in the system. (M.O.W.)

52761 PROFILE MEASUREMENTS OF PLASMA COLUMNS USING MICROWAVE RESONANT CAVITIES. Vlachos, Michael A. W.; Hsuan, Hulbert C. S. (Univ. of Iowa, Iowa City). J. Appl. Phys., 39: 5009-13(Oct. 1968).

The density profile of a positive column of a gas discharge is measured by the comparison of two microwave cavity measurements. The two cavity modes used are the TE_{011} and TM_{020}. (auth)

52762 MEASUREMENT OF PLASMA ELECTRON DISTRIBUTIONS USING MICROWAVE CAVITIES. Burkley, C. J.; Sexton, M. C. (University Coll., Cork, Ireland). J. Appl. Phys., 39: 5013-16(Oct. 1968).

A new technique is presented whereby electron radial distributions in the positive column of a mercury plasma were determined using simultaneous measurements from TM_{020} and TE_{011} microwave cavities. Experimental results are compared with a comprehensive set of theoretical radial distributions. (auth)

52763 PROBE MEASUREMENTS IN MOVING LAYERS. Gundermann, S. (Institut fuer Gasentladungsphysik, Greifswald, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 10: 234-5(1968). (In German).

Studies were made on the externally excited p layer in a neon discharge in the pressure region from 0.8 to 2.3 torr. Field intensity measurements showed that at small oscillations the variations are sinusoidal, but at larger amplitudes they show a strong harmonic pattern. The modulation of the field intensity follows the carrier density variations. The equal-phase points lie on a curve. The frequency dependence of the field intensity and electron temperature oscillations indicate a behavior similar to the amplification. The determination of the time correlation showed that the field intensity maximum occurs before the electron temperature maximum and this before the carrier density maximum. (J.S.R.)

52764 X RAYS FROM A PLASMA IN A MIRROR FIELD HEATED BY LINEAR TURBULENT HEATING. Matsukawa, Yoshinobu; Nakagawa, Yoshiro; Watanabe, Kenji; Uyama, Tadao (Osaka City Univ.). J. Phys. Soc. Jap., 25: 925-6(Sept. 1968).

Fully ionized hydrogen plasma is injected into a mirror field and then this plasma is heated by linear discharge between the region near the gun and the high voltage negative electrode. The maximum magnetic field is 3.4 kG at the mirror maximum, mirror ratio is 2.4, the density of the injected plasma is about 1.10^{12}/cc and discharge voltage is 17 kV. X-ray measurements taken from this apparatus are described. (M.O.W.)

52765 PROCESS AND DEVICE USED FOR MEASURING VERY HIGH TEMPERATURES. Berthelot, Charles (to EURATOM). British Patent 1,129,989. Oct. 9, 1968. Priority date Dec. 21, 1964, Belgium.

A method for measuring very high temperatures ranging from 0.3 to 20 eV or 3,000 to 200,000°K is presented. The intensities of at least two pairs of spectral lines from different elements in a plasma in thermodynamic equilibrium are measured, and from these ratios the temperature is calculated. (W.H.K.)

Kinetics of Plasma

Refer also to abstracts 52509, 52582, and 52676.

52766 (AD-669570) SHOCK WAVE STRUCTURE IN GAS MIXTURES AND PLASMAS. Sinclair, S. R. M. (Toronto Univ. (Ontario). Inst. for Aerospace Studies). May 1968. 106p. (UTIAS-130; AFOSR-68-0576). CFSTI.

The research was concerned with a theoretical description of shock wave structure in gaseous mixtures when diffusive effects are important. The problem considered in detail is the structure of a shock wave in a helium–argon mixture in which the argon is present in very small concentration. An anomalous result, cited in the literature, suggesting that the argon undergoes an initial pre-expansion before compression, was analyzed to show the theoretical origin of this effect. The velocity distribution of a trace of heavy gas (and its lower moments) are watched as the heavy particles pass through a Mott–Smith background shock of lighter particles. The Mott–Smith background is chosen because its bimodal Maxwellian form provides an analytical determination of the free path to the next event for the heavy test particle at any point along its trajectory. This so-called Monte Carlo solution to the idealized diffusion shock problem can be used as a standard for evaluating the diffusion equations derived from various kinetic theory approximations. A number of systems of moment equations of the heavy particle Boltzmann equation were solved and the resulting heavy particle moment profiles compared with those of the Monte Carlo solution. A second strong diffusion problem was analyzed from a kinetic theory point of view. It was found experimentally that the ion density profile through a shock in a weakly ionized plasma with elevated electron temperature is much more diffuse than the neutral atom shock. The theoretical analysis shows that this strong diffusion effect can be attributed to the electrical coupling between the ions and the hotter electron gas. (auth) (USGRDR)

52767 (AD-669572) PLASMA FRONT STUDIES. Final Report, March 1, 1966–February 29, 1968. Barach, John Paul (Vanderbilt Univ., Nashville, Tenn. Dept. of Physics). Mar. 8, 1968. 8p. (AFOSR-68-1034). CFSTI.

A summary is given of work done in 1966–1967 on behavior of electric shock tube plasmas. Mention is made of magnetic interaction experiments (flux transport and induction generator), arc spectroscopy, and shock flow experiments at both high and low density. Throughout, the importance of ejected driver material is emphasized; the flow is basically blast wave in character. (auth) (USGRDR)

52768 (AD-672247) ANALYTICAL SOLUTION OF THE ENERGY BALANCE EQUATION FOR THERMAL INDUCTION PLASMAS IN ARGON. Eckert, Hans U. (Aerospace Corp., El Segundo, Calif.). Apr. 1968. Contract F04695-67-C-0158. 15p. (TR-0158(3220-50)-2; SAMSO-TR-68-243). CFSTI.

The Heller–Elenbaas equation for electric arcs is applied to the case of a thermal induction plasma in argon at atmospheric pressure. The dissipated electrical energy is considered to be predominantly lost by conduction to the side walls. For obtaining a

solution in closed form, the variation of the induced electric field with radial distance is assumed to follow a power law and use is made of the experimental finding that for argon at moderate temperatures the electric conductivity increases approximately in proportion with the Schmitz heat conduction potential. These two steps permit solving the equation by a Bessel function where a transformed radial coordinate accounts for the field nonuniformity. The solution yields the relative distributions of conduction potential and electric conductivity and shows that with decreasing skin depth these distributions tend toward a rectangular shape. The condition that the profiles vanish at the tube wall establishes an eigenvalue for the induced electric field at this position. From this expression, in combination with the induction law and Poynting's theorem, a relationship between the skin depth and the applied rf magnetic field is obtained which permits determination of the values of conductivity and temperature at the tube axis and thus also their absolute distributions from external conditions. These conditions can be collectively expressed by the time rate of change of applied magnetic flux which emerges as the significant independent parameter. The argon plasma could not be maintained below a flux change of 25 V and dissipates energy most efficiently at about 32 V. (auth) (USGRDR)

52769 (AD-672249) ELECTRICAL CONDUCTIVITY OF A SEEDED NITROGEN PLASMA. Final Report. Garrison, G. W. (Arnold Engineering Development Center, Arnold Air Force Station, Tenn. ARO, Inc., Arnold Air Force Station, Tenn.). July 1968. Contract F40600-69-C-0001. 43p. (AEDC-TR-68-116). CFSTI.

The electrical conductivity of a nitrogen plasma seeded with potassium (in the form of powdered K_2CO_3) was measured experimentally under conditions similar to those present in MHD accelerators and compared with existing theory. By accounting for the nonuniform temperature profile in the flow, reasonable agreement between theory and experiment was found. The nitrogen vibrational mode was equilibrated at the gas temperature, and the degree of electron thermal nonequilibrium was found to be small with an energy loss factor of between 50 and 100 indicated for the electron–nitrogen interaction. The free potassium in the gas was determined to be 50% or less of the amount expected based on complete vaporization of the K_2CO_3 added to the gas. This was attributed to incomplete vaporization of the seed and seed condensation on the apparatus walls. (auth) (USGRDR)

52770 (AD-672516) SINGULAR-PERTURBATION METHODS APPLIED TO MAGNETOGASDYNAMICS AND PLASMA PROBLEMS. Final Report, June 1, 1965–May 31, 1968. Chang, I-Dee (Stanford Univ., Calif. Dept. of Aeronautics and Astronautics). May 25, 1968. 8p. (AROD-4284:8-E). CFSTI.

The research activities fall in two categories: (a) the effect of a magnetic field on the hydrodynamic turbulence in ionized gas; and (b) motion of particle suspensions in viscous fluids. (auth) (USGRDR)

52771 (CONF-671127, pp 215-60) THE EFFECTS OF A HIGH-FREQUENCY RESONANT FIELD ON THE PLASMA BEHAVIOUR IN MAGNETIC FIELD. Consoli, T. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

Theoretical and experimental studies on the interaction of a stationary or progressive electromagnetic hf field with a plasma in a mirror-like magnetic field are in progress at Saclay. The aim of this research is the noncollisional energy transfer from the wave to the plasma, in view to get plasma acceleration and reflection. Descriptions are given for the following: (1)the features of the obtained beam and the measurements used for this proposal, (2) the acceleration of a laser-produced dense plasma puff, and (3) the effect of a pulsed mirror field on the acceleration beam. (auth)

52772 (CONF-671127, pp 261-6) SELF-CONSISTENT FIELD AND POWER ABSORPTION FROM ELECTRON CYCLOTRON RESONANCE IN A HIGH-FREQUENCY PLASMA ACCELERATOR. Brambilla, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

Plasma acceleration by electron cyclotron resonance in a mirror-like magnetic field is considered. The absorption and reflection coefficients are evaluated by a method which avoids the use of the WKB approximation. A maximum of absorption is found when $\omega_p^2/\omega^2 \simeq |B^{-1}\partial B/\partial_z|(\omega/c)$; at very high density the wave is strongly reflected. (auth)

52773 (LA-3844) EQUILIBRIA OF COLLISIONLESS PLASMA. Morse, Richard L. (Los Alamos Scientific Lab., N. Mex.). Dec. 1967. Contract W-7405-eng-36. 18p. Dep. CFSTI.

A brief exposition is given on the current theoretical "conventional wisdom" about θ pinch equilibria and the related effects of end shorting, from the point of view of the Vlasov equations. (auth)

52774 (MPI-PAE/PL-6/68) COMMENTS ON "TURBULENT SHOCK WAVES IN PLASMAS." Biskamp, D.; Pfirsch, D. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). May 1968. 8p. Dep.

A brief theoretical discussion of a collisionless shock wave is presented. (M.O.W.)

52775 CONDITIONS FOR THE STEADY ONE-DIMENSIONAL MOTION OF A CURRENT SHEET. Burton, Rodney L. (Univ. of California, San Diego, La Jolla). Phys. Fluids, 11: 2284-6 (Oct. 1968).

Current sheets generated in pulsed plasma accelerators propagate into a cold gas with zero initial conductivity. These sheets can possess a steady, one-dimensional structure only if the conductivity of the fluid behind the sheet is also zero. (auth)

52776 EXPERIMENTALLY DETERMINED STRUCTURE OF THE SHOCK REFLECTION PROCESS IN IONIZING XENON. Smith, Jerome A. (California Inst. of Tech., Pasadena). Phys. Fluids, 11: 2150-61(Oct. 1968).

The results of an experimental investigation of the reflection of strong shocks in xenon from the end wall of a shock tube are presented. The reflection of the incident shock structure, consisting of a frozen shock front, a region of relatively uniform frozen flow, and an ionization front, was observed with a fast-rise (0.3 μsec) pressure gage mounted in the shock-tube end wall. The incident shock Mach number was varied from 11 to 20, and the initial pressure was varied from 0.1 to 1.5 mm Hg. The interaction between the reflecting shock and the ionizing gas in the incident shock structure produces a complicated series of shock and rarefaction waves; those waves that propagate back to the end wall were observed with the pressure gage. A simple model which includes the gross features of the shock reflection process is used to calculate end wall pressures. The calculated pressures agree well with the experimental observations. In addition, ionization relaxation times for xenon behind the incident and reflected shocks are presented. The relaxation time data yield a better understanding of the ionization relaxation process in monatomic gases and provide an estimate for the electron–atom, inelastic cross section for xenon. (auth)

52777 INITIAL IONIZATION RATES AND COLLISION CROSS SECTIONS IN SHOCK-HEATED ARGON. McLaren, T. I.; Hobson, R. M. (Queen's Univ. of Belfast). Phys. Fluids, 11: 2162-72(Oct. 1968).

The initial ionizing processes in shock-heated argon are investigated in a low-pressure, 4.5-in.-dia, shock tube using double electrostatic probes to measure the ionization rates. The experimental conditions cover a range of initial pressures of spectroscopically pure argon from 0.2 to 3.0 torr and temperatures from 7000 to 12,000°K. The maximum impurity level at 1 torr is less than 7 parts per million. Correction terms are applied to take account of flow nonuniformities in shock tubes operating at low initial pressures. The cross section for excitation, σ^*, in the reaction $A + A \rightarrow A^* + A$ is assumed to vary as $S_1^*(E - E_1^*)$ and S_1^* is measured to be 2.5×10^{-20} cm^2/eV. The cross section for ionization, σ^+, in the reaction $A^* + A \rightarrow A^+ + A + e$ is assumed to vary as $S^+(E - E_2')$ and S^+ is found to be 5.1×10^{-17} cm^2/eV. The corresponding rate constants k^* and k^+ are given for this temperature range. (auth)

52778 NONLINEAR INTERACTIONS OF POSITIVE AND NEGATIVE ENERGY WAVES. Aamodt, R. E. (Univ. of Texas, Austin. Austin Research Associates, Inc., Tex.); Sloan, M. L. Phys. Fluids, 11: 2218-23(Oct. 1968). (ORO-3458-7).

Nonlinear resonant three-wave interactions are examined for a number of weakly inhomogeneous plasmas with available free energy. It is shown that for some resonant interactions the necessary and sufficient conditions for the existence of unbounded solutions to the interaction equations reduce to simple criteria. For a number of different realizations of electron and ion beams these criteria indicate that the longitudinal modes in these systems lead to large fluctuations even for wavelengths and beam velocities for which the modes are linearly stable. (auth)

52779 PENNING DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC MIRROR FIELD. Hopfgarten, N.; Johansson, R. B.; Nilsson, B.; Persson, H. (Royal Inst. of Tech., Stockholm). Phys. Fluids, 11: 2272-7(Oct. 1968).

In a Penning discharge in a magnetic mirror field with an axial mirror ratio $B_{max}/B_{min} = 40$, a burning voltage as high as 20 kV with a current of a few amps is observed. Normally, the gas is hydrogen in the pressure range 10^{-4} to 10^{-3} torr. The classical mean free path is longer than or comparable to the dimensions

of the device. From calorimetric measurements on the cathodes, the plasma density and ion energy in the cathode regions are estimated to a few times 10^{10} cm^{-3} and a few keV, respectively. Magnetic loop measurements in the anode region indicate a plasma energy density in that region of 10^{12} to 10^{13} eV/cm^3. Neutral particles, emitted perpendicular to the magnetic field, with energies exceeding 4 keV, are observed with a scintillator. Measurements on a split anode show oscillations in the frequency range 3 to 20 kHz. The aim of the experiment is to investigate the potential distribution in this type of low-density plasma, in particular the electric field component parallel to the magnetic field, and to determine typical energies of the plasma particles. (auth)

52780 NONLINEAR PROPAGATION OF A MODERATELY STRONG ELECTROMAGNETIC WAVE IN A FULLY IONIZED PLASMA. Kaw, P. K.; Salat, A. R. (Princeton Univ., N. J.). Phys. Fluids, 11: 2223-32(Oct. 1968). (MATT-598).

The nonlinear effects resulting from the propagation of a moderately strong electromagnetic wave in a fully ionized plasma are investigated; a detailed study of the case, when the incident frequency is in the vicinity of the plasma frequency, has been made. The nonlinear contributions to the absorption of the wave and to the reflected components from a plasma-free space interface, have also been obtained. It is shown, in contrast with earlier work, that under some conditions the nonlinear effects can increase the absorption. The generation of harmonic components in the current density and the reflected wave has also been studied. (auth)

52781 RESPONSE OF A ONE-DIMENSIONAL VLASOV PLASMA TO EXTERNAL ELECTRIC FIELDS. Harding, Rollin C. (Univ. of Iowa, Iowa City). Phys. Fluids, 11: 2233-40(Oct. 1968).

The nonlinear response of a Vlasov plasma has been calculated numerically for several externally applied electric field configurations. In the presence of a standing wave of frequency $\omega_0 \gtrsim \omega_{pe}$, the energy of the particle distribution and the envelope of the particle electric field were found to oscillate slowly with approximately the period of the trapped particles. Analogous spatial oscillations have been reported by Malmberg and Wharton. Bernstein, Greene, and Kruskal equilibria were calculated for a constant, sinusoidal inhomogeneity in the background ion charge density and found to be numerically stable against small perturbations. Landau-damping rates for the perturbations are compared with the calculations of Jackson and Raether. In the presence of a slowly varying ($\omega_0 \ll \omega_{pe}$) inhomogeneous background (simulating an ion acoustic wave) the electrons were found to obey a locally isothermal equation of state to within a few percent for the times that could be calculated. The response of an initially uniform plasma to a suddenly applied external field was also calculated. (auth)

52782 NONLINEAR AND COLLISIONAL EFFECTS ON LANDAU DAMPING. Denavit, J.; Doyle, B. W.; Hirsch, R. H. (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 11: 2241-50(Oct. 1968).

In the collisionless case, nonlinear effects considerably reduce Landau damping after times of the order of the period of oscillations of trapped electrons. A perturbation analysis of the nonlinear Vlasov equation, modified by the addition of a simplified Fokker–Planck collision term, is carried out following Montgomery's expansion technique. The modified Landau poles for Maxwellian plasmas are determined. The first-order number density and the second-order spatially homogeneous distribution function are evaluated. A numerical solution of the same equation, using the method of velocity Fourier transforms, is also presented and the results of the two methods are compared. Several values of the collision parameter β, wavelength λ, and initial amplitude ϵ are considered, showing the competing effects of nonlinearities and collisions on the formation of a plateau in the spatially homogeneous distribution function. Values of β which prevent the formation of the plateau and maintain Landau damping close to the value prescribed by the linear theory are determined. (auth)

52783 ION ACOUSTIC WAVE DISPERSION IN A HIGHLY IONIZED ARGON PLASMA IN A MAGNETIC FIELD. Levin, Richard R.; Oleson, Norman L. (Naval Postgraduate School, Monterey, Calif.). Phys. Fluids, 11: 2251-8(Oct. 1968).

Ion–acoustic waves have been magnetically excited and optically detected in a highly ionized argon plasma in the presence of a longitudinal magnetic field. The dispersion of the waves has been studied as a function of the exciting frequency between 187 and 352 kHz and with the confining static magnetic field in the range 800 to 2200 G. A dispersion relation is derived which includes the combined effects of ion drift velocity, ion thermal motion, damping, axial magnetic field, and finite beam geometry as adjustable parameters. Dispersion curves are presented which compare the experimental data to the dispersion relation, the parameters being evaluated by a least-squares fit. The agreement is good. (auth)

52784 ESTABLISHMENT OF A GENERAL RULE FOR A HOLLOW-CATHODE ARC DISCHARGE. Delcroix, J. L.; Minoo, H.; Trindade, A. R. (Faculte des Sciences, Orsay, France). J. Phys. (Paris), 29: 605-10(July 1968). (In French).

For a hollow-cathode arc discharge with a gas flow, a hypothesis is proposed for determining the location of the cathode active zone (maximum temperature region). In the case of argon gas with tantalum cathode tubing, the following rule is suggested for different cathode diameters and gas flow rates. The abscissa of the active zone is determined by the condition $P_1 = 4$ torr = constant, P_1 being the gas pressure in this abscissa. The experimental results are in very good agreement with this rule. (auth)

52785 "RADIATION CONDITION" AND "ANTIRADIATION CONDITION". Lafon, J. P. (Observatoire de Paris, Meudon, France). J. Phys. (Paris), 29: 579-86(July 1968). (In French).

A justification is given for the "radiation condition" for the case of a cold, homogeneous, anisotropic, collisionless plasma. Such a condition is necessary for the calculation of the steady-state Green's function for radiation. The argument proceeds from the consideration of an antenna immersed in the plasma and excited by a periodic current beginning at a certain time (the "switchon" time). A separation is made between the steady-state emitted waves, and those waves which either decrease with time or represent normal modes of the plasma. This permits a definition of E_{out} as the "outgoing" field emitted by the antenna. Several different ways of expressing the radiation condition are developed. This condition has no application in the presence of collisions, but when the collision frequency tends to zero it becomes necessary. Another field E_{in}, the "ingoing" field, which has no physical reality is related to an "antiradiation condition," and several expressions of this condition are given. (auth)

52786 EQUATION OF STATE OF A HYDROGEN PLASMA. Roger, C.; Salmon, J. (Conservatoire National des Arts et Metiers, Paris). J. Phys. (Paris), 29: 587-96(July 1968). (In French).

The equation of state of a fully ionized plasma, making allowance for the three kinds of possible interactions (electron–electron, electron–ion, ion–ion) was established. The study was restricted to the case of hydrogen plasmas, because of the remarkable simplifications that come out with the latter. Both R–S's and Kirkwood's hypotheses were taken as a closure hypothesis of the equation governing double densities. Divergences were removed, thanks to the introduction of a notion of closest possible distance, and many expressions were obtained with which numerical applications were made. (auth)

52787 DIELECTRON RECOMBINATION. Beigman, I. L.; Vainshtein, L. A.; Syunyaev, R. A. Usp. Fiz. Nauk, 95: 267-91 (June 1968). (In Russian).

A review of the theory and a series of the application of dielectron recombination is presented. The latter is presented as one of the three possible mechanisms of the recombination of electrons and ions in plasma. As recent studies have shown, dielectron recombination is often the predominant mechanism under conditions of very rarefied plasma, and its ionization equilibrium was determined. The role of dielectron recombination in the population of high-excitation levels is considered at some length. It was shown that for a large groups of levels, the populating because of dielectron recombination is much higher than in thermodynamic equilibrium conditions. The theory of dielectron recombination in the absence of concurrent processes is examined. The role of secondary ionization and photoionization is considered. The role of dielectron recombination in astrophysics, especially in a series of phenomena in solar corona, is considered. Graphs and tables for the coefficients of dielectric recombination and ionization equilibrium are given for a series of elements. (tr-auth)

52788 RESONANCES IN AN INHOMOGENEOUS PLASMA COLUMN. Polman, J. (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Ned. Tijdschr. Natuurk., 34: 102-11 (Apr. 1968). (In Dutch).

The theory of dipole resonance and electro-acoustical resonance is described. Some experimental methods and results were summarized. (J.S.R.)

52789 FUNCTION OF ELECTRON DISTRIBUTION IN INHOMOGENEOUS SLIGHT-IONIZED PLASMA. Nastoyashchii, A. F. At. Energ. (USSR), 25: 308-13(Apr. 1968). (In Russian).

The calculation of the function of electron distribution in inhomogeneous plasma is discussed. It is shown that within the framework of the Davydov approximation this problem may be

reduced to the solution of a certain differential equation in partial derivatives of the second order with corresponding boundary conditions that should be defined by initial conditions. Some examples of the analytic solutions of this equation are given. In particular the solution for a Lorentz electron gas in the plane layer of inhomogeneous plasma is obtained. The relaxation of the electron beam near the cathode due to interelectron collisions is considered. In the Appendix the general expression is developed for electron rate distribution in homogeneous electric and magnetic fields which takes into account both electron–electron collisions and "cooling down" of electrons due to collisions with heavy particles. (auth)

52790 EXPERIMENTAL INVESTIGATION OF THE INTERACTION OF PULSE-DRIVEN ARGON PLASMA WITH A TRANSVERSE MAGNETIC FIELD. Chutov, Yu. I. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 3-7(Apr.-June 1968). (In Russian).

A moving plasma was generated in a linear electric discharge collision tube filled with Ar at a pressure of 0.5 mm Hg. The plasma parameters were determined by means of a double probe. The volt–ampere characteristics of the cooled detachable electrodes introduced into the plasma were studied experimentally. The potential distribution in the gap between the electrodes was measured. The measurements were made both with externally imposed electromagnetic fields on the cathode and under the condition that the field was induced by the moving plasma in the transverse magnetic field. The results showed that in the flow of the current during the induced electromagnetic field the magnetic field does not show a substantial effect. All changes of the voltage with time in the circuit both in the case of imposed and induced field are centered in the narrow pre-electrode layer, distributed close to the electrode in which the current was joined by ions from the plasma. (tr-auth)

52791 CALCULATIONS ON THE EXOTHERMAL WAVE OF AN IONIZING GAS IN A MAGNETIC FIELD. Gusika, P. L.; Sukhov, G. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 13-18(Apr.-June 1968). (In Russian).

The flat exothermal waves of an ionizing gas in a transverse magnetic field were examined. The wave was conditionally divided into three zones, and it was assumed that the reaction with thermal release occurs in the middle zone. Basic calculations were made for the case when the interaction of the current with the field begins in the first zone with attainment of temperature of certain effective values $T = T_*$. At $T < T_*$ the gas was considered nonconducting ($\sigma = 0$) and at $T \geq T_*$ it is ideally conducting ($\sigma = \infty$). The collision adiabatics of the exothermal wave ($q > 0$) of the ionizing gas in the magnetic field, in contrast to general gasodynamics, passes to the plane $\tilde{p} = p + B^2/2\mu$ and $V = \rho^{-1}$ and higher and lower points $\tilde{p}_0$ and V_0, corresponding to the original state. At some magnitudes of the thermal release $q = q_*$, depending on the intensity of the magnetic field and the parameters of the gas imposed on the wave, the shock adiabatic curve passes through the point of the original state. The calculation of the state from the exothermal wave shows that the effect of the magnetic field on the wave velocity is insignificant up to $\pi \sim 10$. During propagation of the stationary detonation wave in the cooled gas, the decrease of the original temperature leads to a drop of the Mach number M_0 of the flow imposed on the wave. (tr-auth)

52792 THE DISSOCIATIVE RECOMBINATION COEFFICIENT OF O_2^+ IONS WITH ELECTRONS IN THE TEMPERATURE RANGE 180^0 TO 630^0K. Smith, D.; Goodall, C. V. (Univ. of Birmingham, Eng.). Planet. Space Sci., 16: 1177-88(Sept. 1968).

The dissociative recombination coefficient, $\alpha(O_2^+)$, of molecular oxygen ions with electrons in afterglows of helium–oxygen mixtures in the temperature range 180 to 630°K was measured by means of a cylindrical Langmuir probe operated in the orbital-limited region of the accelerating characteristics for electrons. Between 295 and 630°K, $\alpha(O_2^+)$ was found to decrease gradually from $(2.1 \pm 0.3) \times 10^{-7}$ cm^3 sec^{-1} to $(1.5 \pm 0.2) \times 10^{-7}$ cm^3 sec^{-1}, the values obtained being in excellent agreement with recent microwave measurements of this coefficient. Observations at 180°K showed $\alpha(O_2^+)$ to be 2 to 4 times greater than the room temperature value and strongly dependent on the discharge pulse power. Retarding probe measurements at 1 msec into the afterglows indicated the electron temperature to be about 200°K greater than the temperature of the containing walls in the range 295 to 630°K. The present results are compared with the temperature variations of $\alpha(O_2^+)$ as inferred from upper atmosphere data, and the ionospheric implications of the measurements at 180°K are discussed. (auth) (UK)

52793 ELECTROACOUSTIC RESONANCE IN PLASMA LAYER SURROUNDING A METALLIC CYLINDER. Ho, Bong; Chen, Kun-Mu (Michigan State Univ., East Lansing). Proc. IEEE (Inst. Elec. Electron. Eng., 56: 1600-2(Sept. 1968).

A cylindrical column of plasma without and with a metallic cylinder imbedded in the center is illuminated by a perpendicular and an axial electric field of a plane wave. Different electroacoustic (Tonks–Dattner) resonances are observed for different arrangements and polarizations. The findings of this study indicate 1) the excitation of an electroacoustic wave by a metallic object in a hot plasma when illuminated by an electromagnetic wave, and 2) the significant effect of an electroacoustic wave on the electromagnetic scattering of a plasma-covered metallic object. (auth)

52794 STATISTICAL CHARACTERISTICS OF HIGH FREQUENCY OSCILLATIONS EXCITED AT THE ONSET OF BEAM-PLASMA INSTABILITY. Yaremenko, Yu. G.; Deev, V. M.; Slabovik, R. L.; Kharchenko, I. F. At. Energ. (USSR), 25: 213-17(Sept. 1968). (In Russian).

By fast-recording oscillograms and following numerical treatment with a computer the procedure is developed for determination of statistical characteristics of oscillations arising when beam instability in nonequilibrium plasma appeared. Time characteristics of correlation functions of instantaneous signal values distribution when oscillations arose in a system of instantaneous spectra are investigated experimentally. The time intervals are determined during which the oscillatory processes are assumed to be stationary from a statistical point of view. The structure of rf oscillations is important for determining of mechanisms of oscillation excitation acceleration and heating of plasma particles. (auth)

52795 STUDY OF MOVING STRIATIONS IN PLASMAS. IV. ELECTRON-ENERGY TRANSFER AND THE DETERMINATION OF THE ELECTRON THERMAL RELAXATION LENGTH. Drouet, Michel G. (Univ., Montreal). Can. J. Phys., 46: 2193-2200(Oct. 1, 1968).

A general expression relating the small variations of the electron density, the electric field, and the electron temperature in a positive column is derived. It is shown that measurements of the variations of these plasma parameters in moving striations of small amplitude and, in particular, of the relative phase of these variations can be used to determine the thermal relaxation length for the electrons in a positive column. The value of the electron thermal relaxation length for a positive column in neon, with a pressure of 1 torr, discharge current 26 mA, discharge-tube diameter 6.5 cm, is found to be approximately 1 cm. (auth) (UK)

52796 EXPERIMENTS ON COLLISIONLESS SHOCK WAVES IN A MAGNETIZED PLASMA. Sakagami, Yukio; Yamanaka, Chiyoe (Osaka Univ.). Oyo Butsuri, 37: 810-14(Sept. 1968). (In Japanese).

A shock wave propagating through a collisionless magnetized plasma is described. The magnetized plasma was produced by a linear z pinch discharge and driven by a conical gun. A sharp shock front appeared, the thickness of which was 2 cm and smaller than the mean collision free path of 8 cm. The magnetic Mach number changed from 1 to 4. In a certain region of plasma which was defined by initial number density, magnetic field intensity and gas atomic number, the shock front had an oscillatory structure. This region seems to correspond to a collisionless shock domain. In such a shock wave, dispersion properties of magnetoacoustic waves and collisionless turbulent dissipation of energy (turbulent heating) become significant. A Rogowski probe detected the drift electrons flowing along the shock front across the magnetic field. These electrons seem to excite the two-stream instability which grows finally into turbulence. A soft x-ray burst was caught by a Be-foil, CsI(Tl) scintillator and a photomultiplier. This seems to endorse the existence of turbulent heating process. (NSA of Japan)

52797 OCCUPATION DENSITY OF QUANTUM LEVELS IN RAPIDLY CHANGING PLASMAS. Bohn, W. L. (Institut fuer Plasmadynamik, Stuttgart). Z. Naturforsch., 23a: 1086-92(July 1968). (In German).

The inadequacy of the quasi steady-state model for the description of rapidly changing plasmas is discussed. Differential equations describing the occupation density of the quantum levels are given and evaluated. The evaluation shows the great effect of the radiation field and the occupation density on the rapid heating and expansion of a plasma. (J.S.R.)

52798 CYCLOTRON-HARMONIC PLASMA-WAVE ECHOES. Porkolab, M.; Sinnis, J. (Princeton Univ., N. J.). Phys. Rev. Lett., 21: 1227-31(Oct. 21, 1968).

Experimental results are presented which show that spatial plasma wave echoes exist with frequencies above the cyclotron frequency and below the plasma frequency. A theory predicting

cyclotron-harmonic wave echoes under the foregoing conditions is found to be consistent with observations. (auth)

52799 ANGULAR DEPENDENCE OF SPIN-WAVE AND PLASMA-WAVE PROPAGATION IN A DEGENERATE ELECTRON LIQUID. McIntyre, B. J.; Ying, S. C.; Quinn, J. J. (Brown Univ., Providence). Phys. Rev. Lett., 21: 1244-5(Oct. 21, 1968).

Results valid in the long-wavelength limit for the angular dependence of all the spin-wave and plasma-wave modes of an electron liquid are presented. Experimental study of the angular dependence should yield a very accurate estimate of differences between successive coefficients in the expansion of the Fermi-liquid interaction function. (auth)

52800 MODEL OF THE DISPERSIVE NONLINEAR EQUATION. II. Yajima, Nobuo (Kyoto Univ.); Outi, Akizi; Taniuti, Tosiya. Progr. Theor. Phys. (Kyoto), 40: 243-63(Aug. 1968).

In a previous paper, a model of the dispersive nonlinear equation was studied for an initial condition; here, the equation is solved for a more general case. A more mathematically rigorous treatment makes clear that the initial-value problem with discontinuity (the Riemann problem) in the dispersive limit is well stated. It is found that the initial condition considered in the previous paper is too special and not stated well, and a significant error in that paper is corrected. (auth)

52801 ION–MOLECULE REACTIONS IN A 50-MHz DISCHARGE. Studniarz, Stanley A.; Franklin, J. L. (Rice Univ., Houston, Tex.). J. Chem. Phys., 49: 2652-9(Sept. 15, 1968).

Extensive investigations of the dependence of the relative ionic composition of a high-frequency plasma on the discharge conditions (particularly the pressure) and of the relative ionic composition of the plasma as a function of the translational energy of the ions issuing from the orifice of the sampling probe at constant pressure were made by the use of a quadrupole mass spectrometer employing a retarding-potential grid system. The results indicate that the ions collected and observed are formed in a narrow region in the plasma (approximately 1 mm in depth) in front of the probe orifice and that these ions gain most of their energy from the electric field of the sheath in a distance that is much less than a reaction mean-free path (~0.01 mm). The average time available for reaction (reaction time) was a few tenths of a microsecond and was independent of the vessel geometry and dimensions. The reaction time was relatively insensitive to changes in pressure and was reasonably constant for ions in several different gases. An explanation is given in terms of a disturbance to the electric fields of the plasma in the vicinity of the probe aperture. (auth)

52802 KORTEWEG–de VRIES EQUATION AND GENERALIZATIONS. I. A REMARKABLE EXPLICIT NONLINEAR TRANSFORMATION. Miura, Robert M. (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 9: 1202-4(Aug. 1968).

An explicit nonlinear transformation relating solutions of the Korteweg–de Vries equation and a similar nonlinear equation is presented. This transformation is generalized to solutions of a one-parameter family of similar nonlinear equations. A transformation is given which relates solutions of a "forced" Korteweg–de Vries equation to those of the Korteweg–de Vries equation. (auth)

52803 KORTEWEG–de VRIES EQUATION AND GENERALIZATIONS. II. EXISTENCE OF CONSERVATION LAWS AND CONSTANTS OF MOTION. Miura, Robert M.; Gardner, Clifford S.; Kruskal, Martin D. (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 9: 1204-9(Aug. 1968).

With extensive use of the nonlinear transformations presented in Paper I of the series, a variety of conservation laws and constants of motion are derived for the Korteweg–de Vries and related equations. A striking connection with the Sturm–Liouville eigenvalue problem is exploited. (auth)

52804 RADIATION SPECTRUM OF HYDROGEN PLASMA OF FINITE THICKNESS. Yakobi, Yu. A.; Komin, A. V.; Ivaniya, S. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 3-5(Feb. 1968). (In Russian).

Calculations were made on the spectroscopic characteristics of hydrogen plasma at temperature above 0.6 eV. Under the assumption of local thermodynamic equilibrium, the volumetric spectral emission properties, the volumetric spectral absorption coefficient, the spectral intensity of the layer of finite thickness, and the integral intensity along the linear wave were calculated. The distinctive characteristics of the work is the calculation of all radiation mechanisms on each wave length. Samples of the curves obtained were reproduced. (tr-auth)

52805 KINETICS OF EXCITED ATOMS IN OPTICALLY DENSE PLASMA. Preobrazhenskii, N. G.; Shaparev, N. Ya. (Novosibirskii State Univ., USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 10-15(Feb. 1968). (In Russian).

The kinetic equations of D'yakonov and Perel' for nondiagonal matrices of the density of excited atoms were transformed. Reduced to the usual classical forms, these equations can be compared easily with the known nonsteady-state equation of Biberman–Veklenko and Holstein for the diffusion of resonance radiation. Those elementary processes, controlling the kinetics of the excited atoms in the plasma, which can be correctly studied for the general quantum mechanical approach to the problem are clarified. (tr-auth)

52806 EFFECT OF RADIATIVE CAPTURE ON THE IONIZATION PROCESS OF PLASMA. Preobrazhenskii, N. G.; Shaparev, N. Ya. (Novosibirsk State Univ., USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk, No. 3, 25-8(Feb. 1968). (In Russian).

Prolongation of the mean lifetime of atoms in the excited state, caused by processes of radiative capture, can substantially alter the character of the growth and decay of the ionization in unsteady plasma. These changes were investigated on a hydrogen plasma by means of the solution of the corresponding kinetic equations. The role of radiative capture was particularly large for electron density $N_e = 10^{14}$ to 10^{15} cm^{-3}, during which at $N_e = 10^{14}$ cm^{-3}, the capture process shortened the time of semi-ionization almost a magnitude. With increase of N_e the effect of suppressing the radiation in the plasma becomes much less significant: for example at $N_e = 10^{17}$ cm^{-3} it changes the ionization time only 5%. (tr-auth)

52807 MOBILITY OF Cs^+ AND K^+ IONS IN VAPOR OF THEIR ATOMS. Palyukh, B. M.; Savchin, L. S. (Lvov State Univ.). Teplofiz. Vys. Temp., 6: 638-40(July-Aug. 1968). (In Russian).

Effective cross sections of the resonance charge exchange, obtained by the retarding field method, were used for the calculation of the velocity of drift ions of Cs and K in vapor of their atoms under the effects of electrical fields of different strengths. The results obtained for Cs agree with the experimental data with respect to the direct determination of the ion mobility. (tr-auth)

52808 PROPAGATION OF ELECTROMAGNETIC WAVES IN PLASMA COLUMNS. De Santis, Pietro. Ing. Nucl., 9: No. 3, 25-31(May-June 1968). (In Italian).

The propagation of an electromagnetic wave in a stationary electron gas, neutralized by a retrostanding complex of immobile ions which do not participate in the propagation phenomenon was studied. (J.S.R.)

52809 STEADY ELECTRIC-FIELD-INDUCED ANISOTROPY IN THE AC CONDUCTIVITY OF A SLIGHTLY IONIZED PLASMA. Kaw, P. K. (Princeton Univ., N. J.). J. Appl. Phys., 39: 5314-16(Oct. 1968).

The anisotropy in the ac conductivity of a slightly ionized plasma, induced by the presence of a strong steady electric field, was investigated. It is shown that for very strong steady fields, the anisotropy is independent of the field strength, its magnitude being solely governed by the dependence of electron-collision frequency on electron velocity; for moderate fields, on the other hand, the anisotropy is a function of the field strength. (auth)

52810 SOLITARY WAVES PROPAGATING AT AN ANGLE TO A MAGNETIC FIELD IN A COLLISIONLESS WARM PLASMA. Inoue, Yoshinori (Osaka Univ.). J. Phys. Soc. Jap., 25: 881-7(Sept. 1968).

Nonlinear hydromagnetic solitary waves propagating at an angle to a magnetic field in a collisionless plasma are investigated taking account of the effect of an isotropic pressure. The transfer equations for electrons and ions are employed together with Maxwell's equations for the electromagnetic field. The plasma is assumed to be fully ionized and quasi-neutral. The inertia of the electron is neglected. The result of the analysis shows that the waves may be classified into six types, two of which are similar to those in a cold plasma. Another four types are newly derived in this paper. That is, class B waves, according to the nomenclature by Cordey, exist in supersonic and subsonic flows. Two types of class A waves may appear in subsonic flows in which no wave propagates along or across the magnetic field. Some waves exist in supermagnetic flows, although only submagnetic waves can propagate in the case of a cold plasma. The width of the wave is of the order of ion Larmor radius. (auth)

52811 EXCITATION OF ELECTRON CYCLOTRON HARMONIC WAVES IN PLASMAS. Hiroe, Shinji; Tanaka, Shigetoshi; Takayama, Kazuo (Nagoya Univ., Japan). J. Phys. Soc. Jap., 25: 874-80(Sept. 1968).

When a magnetoplasma is irradiated by an external microwave, the frequency of the excited subsidiary resonance waves is the

same as that of the external microwave, even if the receiving frequency is not equal to the frequency of the external microwave. Experimental studies of their dispersion relation show that there is a forbidden band proposed theoretically by Bernstein. In order to investigate an excitation mechanism of these resonance waves, the half-width of the intensity distribution curves are measured for the various plasma parameters. These half-widths are independent of the gas pressure, but strongly depend on the diameter of the plasma column. (auth)

52812 ON RADIATION REACTION OF A CHARGE MOVING IN A STRONGLY MAGNETIZED PLASMA. Eidman, V. Ya. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1147-51(1968). (In Russian).

It is shown that the increase of the amplitude of oscillations may occur due to the effect of radiation reaction when an oscillator moves in a strongly magnetized plasma. The region of instability of motion is found. The radiation reaction for a charge moving in a waveguide filled with a strongly magnetized plasma is also considered. (auth)

52813 THE THEORY OF TRANSFER PHENOMENA IN PLASMA CAUSED BY RADIATION PROCESSES IN A STRONG MAGNETIC FIELD DRAG EFFECT. Tskhakaya, D. D. (Inst. of Physics, Tbilisi, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1152-9(1968). (In Russian).

Derivation of kinetic equations is given for electrons and photons in inhomogeneous plasma in a strong magnetic field under the condition that the main mechanism of interaction is the radiation collisions. The self electromagnetic field of an electron is taken into account in radiation-collision integrals. The expressions for diagonal kinetic coefficients determining the transverse fluxes of charge and energy are derived. Due to photon gas drag by electrons, the kinetic coefficients considerably depend on the distance between the mirrors limiting the plasma. (auth)

52814 LINE RADIATION OF CARBON AND FLUORINE PLASMA IN THE TEMPERATURE RANGE FROM 10,000 TO 100,000°K. Derevshchikov, V. A. Teplofiz. Vys. Temp., 6: 540-3(May-June 1968). (In Russian).

Line radiation energy of fluorine and hydrogen plasma was calculated in the temperature range from 10,000 to 100,000°K and concentrations from 10^{16} to 10^{18} cm^{-3}. The C^1 and F^1 atoms and C^2, C^4 and F^2 and F^6 ions were studied and the transitions to the ground state and first and second excited levels are tabulated. Data obtained show that the variations in carbon plasma composition produce at certain temperatures a reduced line radiation due to the appearance of He-like C^5 ions with higher (over 300 eV) excitation potential. The energy of fluorine plasma in the temperature range from 50,000 to 60,000°K is somewhat lower than the energy emitted by carbon plasma. At higher temperatures, the ratio is reversed. The kinetic energy of carbon and fluorine particles at 10^6 to 10^7 cm/sec velocities, observed in electrodynamic accelerators, becomes comparable to the energy emitted by the particles during their distribution in the discharge (1 to 10 μsec at real plasma jet of 10 cm). Thus, it is shown that it is erroneous to assume small radial losses in the range of temperatures examined. (R.V.J.)

52815 CURRENT OSCILLATION IN HOLLOW-CATHODE DISCHARGE. Nadjakov, G.; Stainov, G.; Martinov, N.; Aladjov, E. (Sofia Univ.). Compt. Rend. Acad. Bulg. Sci., 21: 521-4 (1968).

Low-frequency oscillations were observed in the discharge current and the region of negative resistance in I–V characteristics when investigating the spectrum of a microwave resonator under hollow-cathode conditions. The results of this study are described. (M.O.W.)

52816 CALCULATION OF THE SYMMETRIC SELF-REVERSE CONTOUR OF SPECTRAL LINES CONSIDERING THE RADIAL DEPENDENCE OF THE PLASMA PARAMETERS. Kolobova, G. A. (Tomsk Politechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 5, 76-81(1968). (In Russian).

The effect of the radial dependence of the form of the original contour and distribution of the concentration of absorbing atoms on the parameters of the symmetric self-reverse contour of spectral lines was investigated. (tr-auth)

52817 CHARACTERISTICS OF STABILIZED ARC IN A CHANNEL WITH DISTRIBUTED GAS SUPPLY. Mustafin, G. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 124-9(July-Aug. 1968). (In Russian).

Electric arc characteristics in a sectioned channel with distributed gas supply were studied. Volt–ampere and thermal arc characteristics were obtained in a wide range of length of additive agent. Distribution of the potential and electric arc voltage at the additional agent zone was investigated. Data obtained showed the feasibility of using the additive agent for increasing the arc voltage and for increasing by two to three times the mean mass enthalpy of the heated gas stagnation in comparison with the ordinary two-chamber plasmatron scheme. (R.V.J.)

52818 EFFECT OF CONDUCTING WALL ON A STRONG MAGNETIZED POSITIVE COLUMN. Sato, Hiroshi; Yano, Masaaki; Ozaki, Yasuo; Nakano, Yoshiei (Tokyo Inst. of Tech.). J. Phys. Soc. Jap., 25: 928(Sept. 1968).

The effect of conducting walls on a positive column in the strong longitudinal magnetic field B, was experimentally examined for He, Ne, and Ar gases. Discharges were run with a pressure range from about 0.08 to about 1.25 mm Hg and with discharge currents up to 300 mA. (M.O.W.)

52819 OBSERVATION OF A TURBULENCE-LIKE SPECTRUM IN A BEAM–PLASMA SYSTEM. Idehara, Toshitaka; Ohkubo, Kunizo; Tanaka, Shigetoshi (Univ. of Kyoto). J. Phys. Soc. Jap., 25: 927(Sept. 1968).

An intense electron beam was injected into a plasma in a magnetic field. Harmonics of the Bernstein mode were excited. Their power spectra can be expressed approximately by $P(f) \propto f^{-5}$. Spectra are discussed. (M.O.W.)

52820 COLLISION OF TWO PLASMA STREAMS. Takeda, Yasumasa; Shimamura, Shin; Saito, Katsunori; Hamada, Shigeo (Nihon Univ., Tokyo). J. Phys. Soc. Jap., 25: 926(Sept. 1968).

An experiment to determine the thermalization of kinetic energy of two colliding plasmas which expand freely into a weak magnetic field is reported. (M.O.W.)

Production of Plasma

52821 (IPP–3/74) NUMERICAL COMPUTATION OF THE PRODUCTION OF A DENSE PLASMA BY IRRADIATION OF A SOLID BY A LASER. Mulser, P.; Witkowski, S. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). June 1968. 13p. (In German). Dep.

The process of formation of a plasma by focusing a high-energy laser on the surface of a solid body is calculated numerically. A one-dimensional one-fluid model is assumed, in which the light energy is absorbed in the produced plasma, corresponding to the local coefficient of absorption and the local light intensity. The degree of ionization is determined by the Saha equation, thermal conductivity being neglected. Numerical results are given for irradiation of a block of solid hydrogen with a light intensity of 10^{12} W/cm^{-2}. The ratio between thermal and kinetic energy proves to be approximately constant. Temperatures of more than 2×10^6 °K and expansion velocities up to 3×10^7 cm/sec are achieved. (auth)

52822 HYDRODYNAMIC MODEL OF A SPHERICAL PLASMA PRODUCED BY Q-SPOILED LASER IRRADIATION OF A SOLID PARTICLE. Fader, Walter J. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Fluids, 11: 2200-8(Oct. 1968).

The motion of a plasma produced by Q-spoiled laser irradiation of a LiH particle has been analyzed as a spherical hydrodynamic expansion of a quasineutral ideal gas of ions and electrons in local thermal equilibrium. Using Dawson's form of the plasma optical absorption coefficient, digital computer calculations were made for laser pulse and particle parameters approximating those of the experiments of Haught and Polk. Calculated distributions of plasma pressure, density, temperature, and velocity are in agreement with solutions obtained for the system of equations by the method of separation of variables. For given laser pulse energy, the calculated plasma energy is maximized for rise times and pulse widths of the order of the time required for expansion of the plasma to the size of the laser focal spot. The calculated energy of the plasma divided by its total number of ions and electrons was found to be approximately independent of the degree of ionization assumed. (auth)

52823 ON THE ELECTRODELESS ARC IN HIGH-PRESSURE AIR. Hollister, D. D. (Philco-Ford Corp., Newport Beach, Calif.). Phys. Lett., 27A: 672-3(Oct. 7, 1968).

A method is presented to measure translational temperatures in hot gases using the electronic excitation temperature describing the energy distribution over the energy levels of an atom as a suitable parameter. The energy distribution itself is determined by means of a quantitative spectroscopic technique which gives absolute values of the energy level populations. The temperature of a low-pressure oxyacetylene flame was measured and found to be 2400 ± 200°K. (auth)

52824 RADIATIVE DECAY OF TANGENTIAL SURFACE PLASMONS. Ritchie, R. H. (Oak Ridge National Lab., Tenn.

Univ. of Tennessee, Knoxville). Phys. Lett., 27A: 660-2(Oct. 7, 1968).

Tangential surface plasmon generation in thin plasma slabs by obliquely incident fast electrons and the subsequent radiative decay of these plasmons are considered theoretically. It is found that the yield depends strongly on the correlation distance for static density fluctuations in the plasma. (auth)

52825 LOW-TEMPERATURE PLASMA ARC SOURCE. Bertinov, A. I.; But, D. A.; Vasyukevich, P. V.; Popov, V. V.; Tsar'kov, V. D. Teplofiz. Vys. Temp., 6: 537-9(May-June 1968). (In Russian).

Design and performance of electric arc sources producing directed long-duration fluxes of rarefied low-temperature plasma are described. The maximum energy which, due to the tungsten cathode erosion, limited the continuous plasma source operation to about 15-min periods, was equal to 300 kW at basic cascade current up to 1500 A. The volt–ampere characteristics of the plasma source main cascade and the distribution of the potential along the basic arc trajectory are given in graphic form. The results of arc temperature evaluation by the stagnation enthalpy and mean conductivity calculated by the voltage and current in the arc did not deviate over 7%. (R.V.J.)

Stability of Plasma

52826 (CONF-671127, pp 1-26) ION CYCLOTRON INSTABILITIES IN THE PHOENIX II EXPERIMENT. Calvert, W.; Cordey, J. G.; Kuo-Petravic, G.; Murphy, E. G.; Petravic, M.; Sweetman, D. R.; Thompson, E. (United Kingdom Atomic Energy Authority, Abingdon (England).. Culham Lab.).

Recent results from the PHOENIX II neutral injection experiment are described. The plasma density achieved with magnetic well geometry is limited to about 5×10^9 cm^{-3} by an instability associated with the ion cyclotron frequency and its harmonics. The harmonic number increases with density and a complex line splitting is observed which may be associated with the axial oscillation frequency of the ions. Phase measurements indicate a half wavelength along the length of the plasma, and a much shorter azimuthal wavelength. Strong coupling to the parallel motion of the electrons is indicated by loop aerial signals and energetic electron ejection through the mirrors. The growth times can be less than a microsecond. At the highest densities some considerable spreading of the ion energy occurs. The properties of this instability are compared with the computations of Beasley and Cordey on electrostatic instabilities of the Harris type. The onset densities for the various harmonics, the ratio $k_{||}/k_{\perp}$ and growth rates are in reasonable agreement. Much of the detailed structure remains to be accounted for but is not unexpected in finite geometry. Preliminary results on the effect of microwave heating of the electrons are described. Complete suppression of the higher harmonics is observed but an instability appears at the fundamental of the ion gyrofrequency. There is evidence for reversal of plasma potential resulting in a considerable cold ion component to the plasma and consequently enhanced fast ion trapping. The preliminary results indicate that a fast ion density of about 10^{10} cm^{-3} with a comparable cold ion density has been achieved. (auth)

52827 (CONF-671127, pp 98-143) DCX-2 MICROINSTABILITY STUDIES. Bell, P. R.; Clarke, J. F.; Kelley, G. G.; Lazar, N. H.; Lyon, J. F.; Stratton, R. F. (Oak Ridge National Lab., Tenn.).

The injected H_2^+ beam was used to study the effect of finite length and electron temperature on the Burt–Harris instability. The dominant energetic proton plasma was suppressed, leaving only the cylindrical plasma shell formed by the spiralling ion beam and its associated cold plasma. Unstable traveling waves near harmonics of the ion cyclotron frequency were observed to propagate both parallel and antiparallel to the beam axial velocity component and in the direction of ion rotation. Although the calculations of Burt and Harris closely modelled the plasma geometry, the short wavelength modes predicted by them to be the most unstable were not observed. Electron Landau damping suppressed these instabilities, leaving longer wavelength modes which agreed with a recent modification of the Burt–Harris theory. The observed instability wavelengths were identified as axial normal modes of the plasma cylinder. The axial and azimuthal mode patterns of the beam-on instabilities in the energetic proton plasma have been measured in detail. The various harmonics have different axial mode patterns, indicating that they are separate instabilities and not a nonlinear manifestation of a single instability. Each mode forms a standing wave pattern which is either symmetric or antisymmetric about the machine midplane, implying reflections at the end of the mirror-confined hot plasma. Outward propagating waves are found in the cold plasma beyond this region that are time correlated with the oscillations in the energetic plasma interior. The energetic plasma instability behavior during the afterglow period following beam turnoff differs considerably from the beam-on behavior, as reflected by changes in the spectrum and correlation properties of the instability rf. After beam turnoff the instability rf changes from being almost continuous to widely separated bursts that are correlated with axial expulsion of cold plasma and slightly increased charge-exchange loss of energetic protons due to instability energy spreading. (auth)

52828 (CONF-671127, pp 196-214) ION-CYCLOTRON INSTABILITIES IN MIRROR-CONFINED ENERGETIC PLASMA IN THE MODEL C STELLARATOR. Brown, I. G.; Rothman, M. A.; Sinclair, R. M. (Princeton Univ., N. J. Plasma Physics Lab.).

A portion of the plasma in the Model C stellarator is heated by ion cyclotron resonance heating and contained within magnetic mirrors ($1.02 \leq R \leq 1.3$). The plasma so formed (10^{12} to 10^{13} cm^{-3}) has little interaction with the main body of toroidal plasma, and has perpendicular ion temperature up to 4 keV while the electron temperature remains at less than 100 eV. The cooling of this energetic plasma (lasting several milliseconds) is accompanied by emission of radiation at frequencies close to the local ion cyclotron frequency and its harmonics. Experimental results are presented of observations of this rf activity, and related to theoretically predicted instabilities of the ion-cyclotron type. There is no correlation between the rf activity and the loss of particles or energy from the mirrors. The containment time seems limited by charge exchange. (auth)

52829 (CONF-671127, pp 350-62) DRIFT-CYCLOTRON INSTABILITY IN MIRROR MACHINES. Fowler, T. K. (California Univ., Livermore. Lawrence Radiation Lab.).

The drift cyclotron instability in mirror machines is reviewed. It has been conjectured that this mode will determine the radial scaling of mirror confinement. The density threshold for instability is higher the larger the ratio of plasma radius R_p to the ion Larmor radius ρ_i. For a given ratio R_p/ρ_i the density threshold is lower for more singular ion energy distributions. The mode occurs at ion-cyclotron harmonics; it results from coupling of ion-cyclotron waves to an electron drift wave. The wavelength is short, less than ρ_i, and thus perhaps difficult to detect. Being a flute mode ($k_{||} = 0$), it is susceptible to stabilization by a sufficient amount of cold plasma at the ends. Stabilization by radial scaling, together with energy spreading of the ions, cold plasma and effects of magnetic curvature, are discussed quantitatively. (auth)

52830 (CONF-671127, pp 374-407) RESONANT LOSS-CONE INSTABILITIES. Beasley, C. O. Jr.; Dory, R. A.; Farr, W. M.; Guest, G. E.; Sigmar, D. J. (Oak Ridge National Lab., Tenn.).

Several aspects of resonant loss-cone instabilities are considered: the general properties of the unstable oscillations, particularly in plasmas containing hot electrons; the stabilization effects resulting from adding low-temperature ions to a hot-ion, hot-electron plasma and varying the energy and angle spread of the hot-ion distribution; and the behavior of these same modes at high densities, approaching reactor values. To date these studies have shown that the instabilities can be weakened or in some cases effectively eliminated by the various procedures studies. Complete stabilization may, however, rely on effects not yet understood, such as the finite length effects mentioned in this report or the effects associated with spatial variation in the confining magnetic field. (auth)

52831 (CONF-671127, pp 408-72) APPROACH TO MICROINSTABILITIES IN FINITE PLASMA SYSTEMS. Cotsaftis, Michel (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires).

After a short discussion of a number of works attempting to include finiteness effects in open-ended systems, the simple model of a plan slab geometry is analyzed taking into account: (1) finite extension of the plasma $L = \alpha z_i$ along the magnetic field lines; (2) existence of an exterior medium (cold, warm plasma or vacuum) between the plasma and conducting plates located at a given distance $z = \pm z_e$ from the symmetry plane of the system; (3) reflection of particles at the plasma boundaries simulating mirror effect; (4) curvature of magnetic field lines simulated by a gravity g; (5) particle density and temperature gradients from the distribution function gradient; and (6) constant shear in the gravity and gradients direction and with the most general equilibrium state. In accordance with the above mentioned effects, the equation of the electrostatic perturbations of the system is given. (auth)

52832 MACROSCOPIC QUASILINEAR THEORY OF THE GARDEN-HOSE INSTABILITY. Davidson, Ronald C. (Univ. of Calif., Berkeley); Voelk, Heinrich J. Phys. Fluids, 11: 2259-64 (Oct. 1968).

The quasilinear stabilization of the garden-hose instability is discussed from a macroscopic point of view with closure in the fluid model obtained by neglecting the effects of heat flow. In order to keep the problem well-posed mathematically finite Larmor radius corrections to the conventional growth rate are retained, which leads to a natural cutoff in the growth rate for sufficiently large wave number. (auth)

52833 CHARACTERISTICS OF RADIO-FREQUENCY-GENERATED PLASMAS IN STATIC MAGNETIC FIELDS. Mumola, P. B.; Powers, E. J. (Univ. of Texas, Austin). Proc. IEEE (Inst. Elec. Electron. Eng., 56: 1493-1502(Sept. 1968).

When plasmas are immersed in static magnetic fields, a number of plasma instabilities are likely to develop. It turns out that in many cases the type of instability which occurs is in some way related to the method used to generate the plasma. One of the easiest and most common ways of generating a plasma is to pass a radio-frequency current through it. On the other hand, very little is known about the behavior of such rf-generated plasmas when immersed in static magnetic fields. Experiments dealing with the behavior of rf magnetoplasmas are reviewed. It is observed in many different rf experiments that, once the static magnetic field exceeds a critical value, the rate at which plasma is transported across the magnetic field is enhanced. This phenomenon, which is known as anomalous diffusion, is accompanied by an onset of fluctuations in plasma density and potential. The characteristics of the experimental onset data are reviewed and compared with the onset conditions of a number of particularly applicable theories. On the basis of this comparison, it is concluded that the ion-acoustic instability comes closest to explaining the experimental behavior of high-frequency discharges in static magnetic fields. (auth)

52834 DYNAMICAL STABILIZATION OF LOW-FREQUENCY MICROINSTABILITIES. Cotsaftis, M. (EURATOM-CEA, Fontenay-aux-Roses, France). Phys. Lett., 27A: 662-3(Oct. 7, 1968).

Stability conditions for flute and universal microinstabilities are given when the magnetic field is periodically time dependent. (auth)

52835 ION CYCLOTRON INSTABILITY IN A STRONG ELECTROMAGNETIC WAVE. Fidone, I.; Granata, G. (EURATOM-CEA, Fontenay-aux-Roses, France). Phys. Lett., 27A: 652-3 (Oct. 7, 1968).

The action of a strong electromagnetic wave on a magnetized plasma has been investigated. It has been found that for sufficiently strong external waves, ion-acoustic longitudinal oscillations, at a frequency near the ion-cyclotron frequency, may be excited. (auth)

52836 INSTABILITIES AND ANOMALOUS DIFFUSION IN THE REFLEX DISCHARGE. Thomassen, K. I. (Stanford Univ., Calif.). J. Appl. Phys., 39: 5017-24(Oct. 1968).

The instabilities of a cold-cathode reflex discharge are studied and their relationship to the observed increase in radial transport above a critical magnetic field is discussed. High-frequency beam-plasma instabilities occurring in bursts, owing to a relaxation phenomenon, and low-frequency resistive drift waves are both found, with the latter appearing to have an important role in transport. (auth)

52837 STUDIES OF ION-CYCLOTRON INSTABILITY IN POTASSIUM PLASMA. Buchel'nikova, N. S.; Salimov, R. A.; Eidel'man, Yu. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 149-54 (July-Aug. 1968). (In Russian).

Excitation of ion-cyclotron instability in a collisionless highly ionized potassium plasma was studied, considering the plasma state and diffusion during developed instability and interactions of ion-cyclotron instability with drift and ion-acoustic oscillations. The experiments were carried out in an installation in which the plasma was formed by thermal ionization of potassium on a 2-cm-wide plate heated to ~2000°K in 600 to 3000 Oe magnetic fields; plasma density was 10^9 to 10^{10} cm^{-3}. Results obtained are in good agreement with published data. (R.V.J.)

Shielding

Refer also to abstracts 51245, 52250, 52477, and 53062.

52838 (AD-662059) A METHOD FOR EVALUATION OF RADIATION SHIELDING DESIGN. Final Report. Suarez, M. A. (National Engineering Science Co., McLean, Va.). Jan. 31, 1967. 142p. (SN-255). CFSTI.

Graphical information relating to fallout protection of various structures is converted to equations, thereby making it possible to computerize engineering calculations. Discrepancies between graphical and numerical methods are also analyzed. (auth) (USGRDR)

52839 (AD-669452) SPECTRAL MEASUREMENTS OF SCATTERED PHOTONS FROM A POINT SOURCE NEAR THE AIR-GROUND INTERFACE. Frank, Allen L. (Naval Radiological Defense Lab., San Francisco, Calif.). Oct. 10, 1967. 59p. CFSTI.

A gamma-ray spectroscopy experiment was performed to measure the scattered photons from a point source near the air-ground interface. Source-to-detector radial distances of 9.7 and 20.6 ft were used for a ^{137}Cs source and 9.7 ft for a ^{60}Co source. The source height was 8 in. and the detector height was about 3 ft. The measured flux was separated into 10-degree vertical angular bins and the data are reduced to photon spectra by a matrix iteration procedure. Comparisons were made between the measurements and corresponding Monte Carlo calculated spectra. The angular exposures also were compared and the buildup factors were presented along with other buildup data from the literature. (auth) (USGRDR)

52840 (ORNL-RSIC-16) USE OF ICRU-DEFINED QUANTITIES AND UNITS IN SHIELDING. Trubey, D. K. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 69p. Dep. CFSTI.

The International Commission on Radiological Units and Measurements (ICRU) and the USA Standards Institute have offered definitions and made recommendations concerning nomenclature that should be adopted to the greatest extent possible in the shielding community. Because of the nuclear engineering context for shielding calculations and design, special problems have arisen. In order to help alleviate some of these problems, a review is presented along with recommendations. Some of these recommendations are controversial and do not represent a consensus of the many reviewers who have contributed to this work. These cases are identified. Discussions are given of terms such as flux density, dose, kerma, energy deposition coefficient, response functions, and buildup factors. (auth)

52841 (ORNL-tr-1906) BUILD-UP FACTORS FOR GAMMA-RAY PENETRATION THROUGH MULTIPLE LAYERS OF REACTOR SHIELDING. Kitazume, Mitsuyuki; Ogushi, Akira. Translated for Oak Ridge National Lab., Tenn.), from Hitachi Hyoron, 49: No. 7, 1-8(1967). 26p. Dep. CFSTI.

Multiple layer transmission experiments were performed using a plane 10-Ci ^{60}Co source to give a monodirectional beam to study means of calculating the dose buildup factors necessary for gamma-shield design. The accuracy of the empirical equations proposed by Kalos, Broder, and Kitazume was checked. The shielding materials studied were water, steel, and lead arranged in combination to build up as much as four layers of shielding. The thickness was extended to a maximum of 8 mfp. The experimental monolayer buildup factor came within a few per cent of coinciding with that obtained from the Kitazume equation for the case of a light-heavy two-layer system. The Broder equation gave results of a few per cent to 20% smaller for the heavy-light two-layer case. The combination of the Broder and Kitazume equations gave results which were 5 to 15% smaller. Generally speaking, there was poor agreement between the results obtained by the Kalos and Broder equations. When calculated values for monolayer buildup factors were taken, the Kitazume equation gave results 5 to 15% greater than the experimentally derived values. The results of this investigation indicate that the calculation of multilayer buildup factors to be used in shielding design is best achieved by combining the Broder and Kitazume equations, and the results should be valid within 15%. (auth)

52842 INVARIANT IMBEDDING AND ABSORPTION PROBABILITY IN SLABS. Nakayama, Takashi; Nishida, Takahiko (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 5: 472-5(Sept. 1968).

The invariant imbedding equation for the absorption probability of slab has been derived from Roussopolos' variational functional. Numerical results obtained on the reflection function agreed well with that of Bellman, et al., and those on the absorption function also coincided with the Monte Carlo calculation. (auth)

52843 BACKSCATTERING OF GAMMA-RAYS FROM SEMI-INFINITE STRATIFIED SLABS OF ALTERNATING TIN AND ALUMINUM LAYERS. Nakamura, Takashi; Hyodo, Tomonori (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 5: 458-63(Sept. 1968).

The backscattering of γ rays from semi-infinite stratified slabs of alternating layers of tin and aluminum was investigated. The

energy spectrum and the angular distribution of backscattered photons, as well as the number and energy albedos, were obtained for ^{60}Co and ^{137}Cs point isotropic sources. They were compared with the data obtained with single layers of tin and aluminum. The stratified slabs of alternating layers were assumed in this study to be equivalent in property to a homogeneous mixture of tin and aluminum, and the effective atomic numbers were computed on this basis. The resulting values are found to agree with the effective atomic numbers corresponding to the albedo values obtained for the alternating layers. (auth)

52844 INVARIANT-IMBEDDING THEORY OF PHOTON TRANSPORT. Kaiser, Richard Edward. Manhattan, Kan., Kansas State Univ., 1968. 168p.

Thesis.

The method of invariant imbedding was applied to the problem of photon transport in the derivation of the differential equations for reflection and transmission functions. The geometry considered was a homogenous slab, infinite in the y and z directions and finite or semi-infinite in the x direction. Incident energies in the range 0.1 to 10 MeV were considered, with the emphasis on the range above 1.022 MeV where pair production occurs. The source was considered to be an infinite plane. The reflection and transmission functions were broken down into scatter and pair-production components, and each of these was then segmented further as to whether the emerging photon is uncollided, singly scattered, or multiply scattered. Uncollided transmission and single-scatter transmission and reflection problems were then solved analytically. A multigroup structure was used to represent the energy dependence and a shifted Gaussian quadrature to represent the angular dependence for values of cosine theta from −1 to 0 or from 0 to 1. No azimuthal dependence was included in the problem. The reflection from a semi-infinite slab was solved by a straightforward iteration procedure, since for this case the derivative of the reflection function was zero. A Runge–Kutta–Gill numerical integration procedure was used to solve for the reflection and transmission in a finite slab. With these techniques the reflection and transmission problems were then solved on a digital computer. Reflection functions from a homogeneous semi-infinite slab were obtained for four materials: iron, lead, concrete, and water. Transmission and reflection from a finite slab were calculated for iron up to the point where the reflection function converged to that obtained for the semi-infinite case. Angular distributions and energy spectra of emitted photons were obtained from all cases, along with total energy reflected or transmitted and total number reflected or transmitted. All output was based on unit input. The source was one photon at a given value of cosine theta (any of the quadrature angles) or an isotropic source, here defined as an incident beam equally distributed in cosine theta. The results obtained from the invariant-imbedding method compared quite favorably with Monte Carlo and moments method calculations and the estimated errors were comparable to those encountered by most other methods. For example the annihilation photons from the pair-production process were found to be 71 percent of the total albedo resulting from 6.13-MeV photons normally incident on an iron slab. This compares favorably with the literature value, obtained by Monte Carlo methods, of 74 percent for the same problem. (TSS) (Disser. Abstr.)

52845 SIMPLE CALCULATION FOR AIR-SCATTERED GAMMA-RAYS. Kitazume, Mitsuyuki (Hitachi Ltd., Japan). J. Nucl. Sci. Technol. (Tokyo), 5: 464-71(Sept. 1968).

A simple formula for air-scattered γ-rays is proposed. The proposed formula is derived using a single-scattering approximation, with exponential attenuation and buildup factor for scattered γ-ray energy. The results of calculation obtained with the formula are compared with those by Monte Carlo method, and by single-scattering calculation without exponential attenuation and buildup, for line beams of mono-energetic γ-rays emitted from a point source. For higher energies, the air-scattered flux and dose rate given by this simple approximation agree fairly well with the Monte Carlo calculations at all beam angles and source-detector distances. The accuracy is within about 10%. The flux and dose rate for γ-rays emitted isotropically from the point source have also been calculated, and are presented as a function of distance. (auth)

52846 A V^0 IMPORTANCE FUNCTION FOR THE MONTE CARLO CALCULATION OF THE DEEP PENETRATION OF GAMMA RAYS. Armstrong, Tony Wray. Knoxville, Tenn., Univ. of Tennessee, 1967. 103p.

Thesis.

The successful application of the Monte Carlo method to problems involving the deep penetration of radiation requires the specification of an appropriate importance function which will identify those regions of the phase space that contribute most heavily to the answer of interest. In the present work an importance function based on the first term (the V^0 term) of the series representation of the value (or adjoint) function is formulated and evaluated. For the case of 1-MeV gamma rays incident normally on thick homogeneous slabs of lead and water, it was demonstrated that this V^0 importance sampling scheme provides considerable improvement over the conventional exponential transform method. For the same computation times, the variance of the dose buildup factor at 21 m.f.p. was reduced by factors of about 125 and 50 for lead and water, respectively. For the particular source-geometry configuration investigated, the improvement was found to be contributed approximately equally by the spatial and polar angle biasing with essentially no improvement provided by the azimuthal angle biasing. (auth) (Diss. Abstr.)

52847 TESTING THE TYPE OF SHIELD CONSTRUCTION IN THE GERMAN BOARD FOR METROLOGY AND GOODS TESTING. Rothe, H.; Guehne, F. (Fachabteilung Ionisierende Strahlung, Berlin). Isotopenpraxis, 4: 186-7(May 1968). (In German).

The ordinance on protection against the damaging effects of radiation requires that the shielding of every device using radiation sources must be approved by the German Board for Metrology and Goods Testing. The procedure for obtaining this approval is outlined. (J.S.R.)

52848 SHIELDING ARRAY FOR CHLORINE LOGGING SONDE UTILIZING NEUTRON AND GAMMA RAY SHIELDING ELEMENTS. Reed, Dale H.; Dunlap, Henry F.; Pritchett, William C. (to Atlantic Richfield Co.). U. S. Patent 3,389,258. June 18, 1968. Filed July 22, 1964.

A shielding array is described for a chlorine logging sonde having a neutron source located in an air-filled chamber at the lower end of the sonde and a detector including a scintillation crystal and a photomultiplier tube located above the source. The shielding array includes a steel shield positioned above the neutron source, a plastic shield above the steel shield, a boron shield above that, a lead shield above that, and a bismuth shield above that and below the scintillation crystal. In this shielding array, a second boron shield extends around the outside portion of the sonde opposite the scintillation crystal. In one embodiment of this array a third boron shield is located above the bismuth shield and below and adjacent the scintillation crystal. (M.H.R.)

Solid-State Physics

Refer also to abstracts 50995, 52171, 52208, 52265, 53095, 53143, and 53191.

52849 (CEA-R-3387) STUDY OF THE EFFECT OF NEUTRON AND ELECTRON BOMBARDMENT ON THE HEAT TRANSFER AT LOW TEMPERATURES OF GERMANIUM AND OF SILICON. Vandevyver, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 74p. (In French). Dep.

Thesis. Submitted to Paris Univ., France.

The main results obtained from this work are the following: (1) neutron irradiation (at 300°K) produces lattice defects in germanium and silicon, and a corresponding very large lowering of the thermal conductivity is observed in the low-temperature region (4 to 300°K). The results obtained have been explained with the help of the following hypotheses: —for silicon a scattering of phonons by the stress fields produced by the defects; —for germanium, a supplementary scattering of the electron-phonon type. (2) annealing treatments carried out on these materials above 373°K restored the thermal conductivity over the whole temperature range of the measurements (4 to 300°K); in the case of both germanium and silicon there were two steps in the annealing process. (3) a study of the thermal conductivity of germanium (initially P or N) after an electronic irradiation showed that the scattering of phonons could depend on the state of charge of the defects thus produced. (auth)

52850 (GEMP-612) RADIATION DAMAGE IN VANADIUM. Rau, R. C.; Ladd, R. L.; Moteff, J. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). [1968]. Contract AT(40-1)-2847. 3p. (CONF-680905-3). Dep. CFSTI.

From 26th Annual Meeting of the Electron Microscopy Society of America, New Orleans, La.

Microstructures of vanadium irradiated at ~70°C to a fast neutron flux of 5×10^{19} n/cm^2 were studied by transmission electron microscopy before and after annealing. The observed defect clusters were found to be stable; this is ascribed to the interstitial impurities and their interaction with the defects. The circular halos of defect clusters around discrete particles are believed to be damage from the $^{10}B(n,\alpha)^7Li$ reaction. (D.L.C.)

52851 (IAE-1476) DYNAMICAL TREATMENT OF THE X-RAY'S THERMAL DIFFUSE SCATTERING. Afanas'ev, A. M.; Kagan, Yu.; Chukhovskii, F. N. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1967. 19p. Dep.

A dynamical theory of the thermal diffuse scattering of x rays from thick crystals is developed which consistently takes into account the elastic Bragg scattering of both the incident and diffuse-scattered x rays. Special attention is paid to analysis of the intensity distribution of the diffuse scattered waves near the Bragg peak. The known singularity of type $1/g^2$ in a thin crystal ($\vec{g} = \vec{\varkappa}' - \vec{\varkappa}_1$ where $\vec{\varkappa}'$ is the wave vector of scattered x rays, and $\vec{\varkappa}_1$ is that corresponding to the Bragg peak) is shown to be transformed to the rather weak singularity $1/g_{//}$ ($g_{//}$ is the projection of the wave vector $\vec{g}$ on the plane parallel to a crystal surface) in the region of small g for the case of a thick crystal. A special analysis is made of the influence of atomic vibration near the crystal surface on the angular intensity distribution of the scattered waves. (auth)

52852 (JINR-P1-4000) EFFECTS OF PARTICLE INTERACTIONS ON THE SHAPE OF THE BRAGG CURVE. Vasilevskii, I. M.; Karpov, I. I.; Prokoshkin, Yu. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 16p. (In Russian). Dep.

Comparisons were made of calculated and measured Bragg curves for protons, deuterons, and α particles with ~1.3 GeV/c momentum. It is shown that the shape of the curve depends on the geometry of the experiment and that calculations of Bragg curves for high-energy particles should take into account nuclear interactions of these particles with attenuating material. (tr-auth)

52853 (UCRL-18315) DETECTION OF NMR BY NUCLEAR RADIATION. Shirley, D. A. (California Univ., Berkeley. Lawrence Radiation Lab.). July 1968. Contract W-7405-eng-48. 40p. Dep. CFSTI.

Progress has been made in the field of detection of NMR in radioactive nuclei through the angular distributions of decay products. Some of the features of such radiative detection of NMR (NMR/RD) are described. NMR/RD is contrasted with conventional NMR. A unified theoretical description of NMR/RD is given, and experimental results are discussed. (D.L.C.)

52854 DEFECTS IN IRRADIATED SILICON: ELECTRON PARAMAGNETIC RESONANCE AND ELECTRON-NUCLEAR DOUBLE RESONANCE OF THE ARSENIC- AND ANTIMONY-VACANCY PAIRS. Elkin, Edward L.; Watkins, G. D. (General Electric Research and Development Center, Schenectady, N. Y.). Phys. Rev., 174: 881-97(Oct. 15, 1968).

Two EPR spectra are observed in irradiated silicon (designated Si-G23 and Si-G24), which are identified with the neutral charge states of a lattice vacancy adjacent to a substitutional arsenic or antimony atom, respectively. EPR and ENDOR studies reveal a high degree of similarity between these defects and the phosphorus-vacancy pair (Si-G8) studied previously. Nuclear quadrupole interactions for the As and Sb atoms give additional information about the defect configuration, not available for the phosphorus-vacancy pair. For all three defects, a large static Jahn-Teller distortion occurs. Analysis of the response of the defects to externally applied stress allows an estimate of ≈1 eV for the magnitude of the Jahn-Teller stabilization energy. It is concluded that this energy is larger than the electron-electron interaction energies and comparable to (or greater than) the crystal-field energies for the electrons involved in the core of the defects. Studies of the group-V atom-vacancy reorientation kinetics reveal variations between the three defects that can be correlated with the elastic interactions between the oversize arsenic or antimony atoms and the tensile strain around the lattice vacancy. Comparison of the results with the annealing studies of electrical properties by Hirata et al., indicate that the annealing of each defect involves the migration of the pair as an entity through the lattice. (auth)

52855 ELECTRON PARAMAGNETIC RESONANCE: TECHNIQUES AND APPLICATIONS. Alger, Raymond S. New York, John Wiley and Sons, Inc., 1968. 594p. $15.95.

A brief survey of EPR nomenclature, theory, and customs is followed by a discussion of spectrometers and associated gear. Details are included for accessories commonly built in the laboratory. Techniques are described for measurement and control of the principal spectrometer and environmental parameters, e.g., frequency, field strength, spin concentrations, relaxation times, temperature, etc. Examples of experimental problems, measurements, and results for specific spin systems in gas, liquid, and solid sample materials are given. The main emphasis is on solids. Descriptions of techniques for irradiation of various materials and results of some radiation damage studies are included. (333 references) (A.G.W.)

52856 ADJUSTING POLES AND ZEROS OF DIELECTRIC DISPERSION TO FIT RESTSTRAHLEN OF $PrCl_3$ AND $LaCl_3$. Berreman, Dwight W.; Unterwald, F. C. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 174: 791-9(Oct. 15, 1968).

The dielectric dispersion function of a medium can be defined by the locations of the poles and zeros of that function in the complex-frequency plane. In this form the dispersion function is not restricted by special characteristics of any specific physical model from which dispersion might be derived. The locations of these poles and zeros are subject to several more or less fundamental physical restrictions described in this paper. The connections between the locations of the poles and zeros, the frequencies and damping constants of certain optical modes, and the Lyddane-Sachs-Teller relation are discussed. Adjustments of locations of poles and zeros, consistent with the physical restrictions, were performed to obtain least-squares fits of reststrahlen data from $PrCl_3$ and $LaCl_3$ using a small number of poles and zeros. In this way, approximate dispersion functions for the two dielectric tensor components of each crystal were obtained at room temperature and at lower temperatures. (auth)

52857 RECOMBINATION RADIATION FROM CdS ON EXCITATION BY FAST ELECTRONS. Gerasimenok, N. N.; Murav'eva, G. A.; Smirnov, L. S. Fiz. Tekh. Poluprov., 2: 917-20(July 1968). (In Russian).

Spectra and kinetics of recombination emission in the range 4800 to 1100 A from single-crystal cadmium sulfide excited by fast electrons and temperature from 80 to 300°K were studied. Descriptions are given of relative mechanisms of radiation recombinations in various bands of recombined emission spectra. Peculiarities of electron excitation are discussed. (tr-auth)

52858 KINETICS OF FORMATION OF ION PHASES DURING IONIC BOMBARDMENT. Gorodetskii, A. E.; Kachurin, G. A.; Smirnov, L. S. Fiz. Tekh. Poluprov., 2: 927-31(July 1968). (In Russian).

Equations were obtained for the kinetics of homogeneous and heterogeneous growth of new phase centers as functions of the specific radiation dose. It was assumed that the nuclei of the new phases are incidental due to the intense atomic mixing in the area of the peak shift during the temperature burst. The concentration of diffused atoms exceed considerably the solubility limit. The diffusion shift of impurity atoms during the shift of impurity atoms during the shift is taken into account. In homogeneous generation, the number of phase centers are determined by the volume of the shifting peak. In heterogeneous generation, the rate of center growth is determined by the radius of the grain and by the peak shift. (tr-auth)

52859 ON THE NATURE OF TRANSITION PROCESSES IN n-Ge AFTER PULSED IRRADIATION WITH FAST NEUTRONS. Starostin, K. L.; Filimoncheva, P. I.; Tuturov, I. F. Fiz. Tekh. Poluprov., 2: 1011-13(July 1968). (In Russian).

Studies of n-Ge specimens with a specific resistance of 10 ohm·cm irradiated by an integral neutron flux of $\sim 2 \times 10^{13}$ n/cm^2 for $\tau \ll 1$ sec at 160 to 285°K showed that the conductivity of specimens reduced 2.5 to 3 times in comparison with the initial. Graphical data are given on the variations in the specific resistance of n-Ge following irradiation by neutron pulsed flux at 160, 208, 275, 268 and 285°K and variations of photoconductivity of the irradiated n-Ge specimen as a function of γ-quantum intensity. (R.V.J.)

52860 DEPENDENCE OF RADIATION DEFECTS IN SILICON ON NEUTRON ENERGY SPECTRA. Mordkovich, V. N.; Sadikov, V. P.; Starostin, K. L.; Ukhin, N. A. Fiz. Tekh. Poluprov., 2: 1032-3(July 1968). (In Russian).

Radiation effects on electric conductivity of silicon was studied with silicon crystals irradiated by neutrons with various energy spectra. Studies were carried out in a reactor using moderated neutrons and neutrons with energy close to fission spectra (60% of neutrons with energy exceeding 0.6 MeV). Results obtained for silicon alloyed with phosphorus showed that, in case of irradiation with moderated neutrons, electric conductivity was very sensitive to the impurity composition of the specimen; under irradiation with neutrons with spectra close to those of fission, the specimens showed no dependence on the impurity content. Fast-neutron bombardment reduced the mobility and changed specimen conductivity about 15%. (R.V.J.)

52861 ENERGY AND ORIENTATION DEPENDENCE OF ELECTRON-IRRADIATION-INDUCED DAMAGE IN UNDOPED GaSb. Thommen, K. (Atomics International, Canoga Park, Calif.). Phys. Rev., 174: 938-45(Oct. 15, 1968).

Undoped GaSb single crystals were irradiated at 77°K with electrons having energies between 0.23 and 1.00 MeV. The incident

electron beam was aligned with either the [111] or the [$\bar{1}\bar{1}\bar{1}$] direction of the sample. The isochronal recovery of the Hall coefficient and the electrical resistivity were measured after each irradiation. The positions and widths of the four major recovery stages were independent of the irradiation energy. The production rates of the defects corresponding to the four stages differed in their energy dependence. Their threshold electron energies were evaluated as 0.34 MeV for stage I, 0.17 MeV for stage II, 0.33 MeV for stage III, and 0.34 MeV for stage IV. Stage-I defect production was higher with the electron beam in the [111] direction than in the [$\bar{1}\bar{1}\bar{1}$] direction. The reverse was the case for stage-II, -III, and -IV defect production. Stage I is attributed to the recovery of defects created by the displacement of single Sb atoms. The threshold displacement energy for Sb atoms is larger than 7.5 eV but smaller than 13.1 eV. Stage II is interpreted as recovery of defects produced by the displacement of single Ga atoms. The threshold displacement energy for Ga atoms is about 6.2 eV. It is suggested that stages III and IV represent the recovery of defects created by multiple displacement processes starting with the displacement of a Ga atom. (auth)

52862 ELECTRON MICROSCOPIC STUDY OF THE TRANSITION FROM AMORPHOUS TO CRYSTALLINE CONDITION OF ELECTRON-BOMBARDED CADMIUM SULFIDE FILMS. **Evans, John C. (Lewis Research Center, Cleveland). J. Cryst. Growth, 2: 184(June 1968).**

Thin films of CdS deposited by cathodic sputtering onto plastic films and glass microslides at room temperatures are normally amorphous. The effect of bombardment of these amorphous films by carefully controlled electron beams was observed within the electron microscope. Some films were treated by the beam in the microscope; others were subjected to bombardment in an external crystallizing apparatus. Amorphous-to-crystalline transformation of the CdS films was observed. The electron beam energy initiated the transformation without causing evaporation of the film. The films of sputtered CdS were examined by transmission electron micrography and electron diffraction before and after treatment. Agglomeration, followed by nucleation and crystal growth, occurred. The polycrystalline electron-diffraction pattern revealed little preferential orientation of the microcrystals. Upon further increase of the beam energy the growth of the crystals progressed to the point of depletion of the surrounding areas and a limit to the crystal size was imposed. The depleted film initially was ~500 Å in thickness; the largest crystal seen is approximately 0.4 μ across in the form of a platelet. The grouping of crystals showed a strong tendency to orient with the c-axis normal to the plane of the film. (BBB)

52863 EQUIVALENCE OF NUCLEI IN HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. **van Gorkom, M. (Unilever Research Lab., Vlaardingen, Netherlands); Hall, G. E. Quart. Rev. (London), 22: 14-29(1968).**

Magnetic nonequivalence of nuclei (predominantly ^{1}H) arises from subtle differences in (average) environment or conformer populations. The existence of these differences does not necessarily lead to observable nonequivalence. Most workers have attempted to accentuate such potential differences by a magnetically anisotropic group such as cyano or phenyl. Any resulting magnetic nonequivalence can normally be qualitatively explained after observation on topological grounds but quantitative prediction is essentially impossible. There is need of more research regarding interaction between groups. Awareness of the possibility of otherwise unexpected magnetic nonequivalence is important in spectral interpretation. Apparent equivalence must not be interpreted as proving the nuclei involved to be identical. It is dangerous to assume that measured splittings necessarily correspond to the coupling constants involved, since the first-order interpretation rules may only be applied to groups of magnetically equivalent nuclei. When 2 atoms (or groups) are distinguishable in an NMR spectrum they may sometimes be differentiated chemically. Exchange and reaction techniques are noted. The principles involved are of value to organic and inorganic chemists in appreciating stereochemical subtleties and in interpreting high-resolution NMR spectra in terms of chemical structures, to the physical chemist investigating barriers to chemical change and the forces of interaction between groups, and to the biochemist needing to distinguish similar groups and trying to understand details of enzymatic action. (BBB)

52864 ELECTRONIC STATES OF DEFECTS IN IRRADIATED OXIDES. **Henderson, B. (Keele Univ., Eng.). pp 41-9 of Mass Transport in Oxides. Wachtman, J. B. Jr.; Franklin, A. D. (eds.). Washington, D. C., National Bureau of Standards, 1968.**

From NBS–ARPA Symposium on Mass Transport in Oxides, Gaithersburg, Md. See NBS-Spec. Publ.-296; CONF-671024.

A review is presented of some of the progress made during the last few years in understanding the electronic states of defects in irradiated oxides, particularly alkaline earth oxides. A short introduction indicating the scope of the work on oxide materials, is followed by a description of the main types of experiment proving useful in the simple cubic oxides. In particular the following topics are discussed: (i) the electron-phonon interaction in the MgO F-center, (ii) the evidence for the F′centers in the oxides, (iii) the annealing of radiation damage and the production of aggregate centers, (iv) the investigation of the structure of defects in oxides using uniaxial stress splitting of optical zero-phonon lines. Some novel results of the EPR spectrum of a triplet (S = 1) state defect in neutron irradiated Al_2O_3 are also discussed, and a new model is proposed for this defect. (auth)

52865 CHANGES IN THE RESISTANCE OF MOLYBDENUM FILMS DUE TO THE ADSORPTION OF CARBON MONOXIDE. **Ansbacher, Theodore Henry. Burlington, Vt., Univ. of Vermont, 1968. 105p.**

Thesis.

The change in electrical resistance of molybdenum thin films was measured as a function of the amount of carbon monoxide adsorbed on them. The films were approximately 200 Å thick, deposited on Pyrex at –78° and 200°C in a vacuum of 1×10^{-8} torr, and annealed at 100° and 200°C for ten minutes. Films deposited at –78°C and annealed at 100°C had a temperature coefficient of resistance ten times smaller than bulk, and adsorbed the equivalent of two monolayers of carbon monoxide. Their resistance increased by 4 to 8%, but not in direct proportion to the amount of gas adsorbed. This is interpreted, in terms of a tentative model, to mean that adsorption is taking place in more than one mode at a time. The probability of adsorption was 1×10^{-3}, in agreement with the lowest reported values. Films deposited at 200°C and annealed at 200°C adsorbed only negligible amounts of carbon monoxide. Silver films were also investigated. These were approximately 200 Å thick, deposited on Pyrex at –78° and 0°C in a vacuum of 1×10^{-8} torr, and annealed at 0°, 100°, and 200°C for ten minutes. The resistance of films annealed at 100°C and 200°C increased to infinity and their appearance changed from silver to white, which is attributed to agglomeration of the films. The films annealed at 0°C showed no measurable adsorption of carbon monoxide or change in resistance. (auth) (Diss. Abstr.)

52866 CHEMICAL SHIFTS IN EUROPIUM STUDIED BY ESCA. **Nilsson, O.; Norberg, C.-H.; Bergmark, J.-E.; Fahlman, A.; Nordling, C.; Siegbahn, K. (Univ. of Uppsala). Helv. Phys. Acta, 41: 1064-70(Oct. 20, 1968).**

Electron spectroscopic measurements have been performed on the 4s, 4p, 4d, and 4f levels of Eu. Shifts in binding energies of about 7 eV are reported between Eu in Eu_2O_3 and Eu in a lower valence state. The 4f level is shifted less than the 4p and 4d levels. (auth)

52867 USE OF AN ELECTRON FILTER IN ELECTRON DIFFRACTION FOR REMOVING INELASTICALLY SCATTERED ELECTRONS. **Alekseev, A. G.; Verkhovskaya, T. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1195-9(1968). (In Russian).**

In forming a diffraction picture the inelastically scattered electrons create a background which distorts the intensity distribution of the diffracted electrons. It is almost impossible to take this effect into account by theoretical means. Hence an electron filter was designed to be used with a commercial electron microscope. The filter consisted of a symmetric, three-electrode, electrostatic lens, in which the two outer electrodes were grounded, and the middle electrode was given the cathode potential. Fast electrons passing through the inlet diaphragm encounter an electric field in the filter that slows them down. Only elastically scattered electrons pass through the filter in the ideal case. Two pairs of adjusting coils at the inlet diaphragm are used to direct the electron beam along the filter axis in order to improve the energy resolution. The electron filter improved the contrast of the diffraction pictures, especially in the case of amorphous substances containing light elements. It was found that the background of inelastically scattered electrons was rather large even in the case of antimony (Z = 51), and was quite substantial in the case of amorphous selenium and carbon. (TTT)

52868 OBSERVATION OF A KONDO EFFECT IN A CONCENTRATED SYSTEM. **Edelstein, A. S. (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Lett., 27A: 614-15 (Sept. 23, 1968).**

Resistance measurements on La–Ce films indicate that the Kondo temperature is 10°K. A resistivity minimum has been observed on a sample containing 20 at. % Ce. (auth)

52869 CHARACTERIZATION OF GROUND-STATE WAVEFUNCTIONS BY MEASURED ELECTRONIC PROPERTIES. I. ^{119}Sn MOESSBAUER ISOMER SHIFTS. **Unland, Mark L.; Letcher,**

John H. (Monsanto Co., St. Louis). J. Chem. Phys., 49: 2706-12(Sept. 15, 1968).

A particular type of LCAO MO wavefunction is applied to the problem of correlating experimental ^{119}Sn Mössbauer isomer shifts with calculated electron densities at the nucleus. The results are found to be sensitive to the choice of basis functions, molecular geometry, and method of setting basis orbital exponents. Because of this sensitivity, only a rough correlation of the isomer shift data is obtained when conventional methods of setting orbital exponents are used. A set of wavefunction parameters that result in good correlation of the ^{119}Sn data is found and, for each molecule, a quantitative measure of the sensitivity of the calculated electron densities to each parameter is obtained. (auth)

52870 COLOR CENTER FORMATION IN PLASTICALLY DEFORMED CALCITE. Sterzel, W.; Chorinsky, E. (Univ., Frankfurt am Main). Z. Naturforsch., 23a: 1052-8(July 1968). (In German).

Color centers with absorptions in the region of visible light arise in calcite crystals under x irradiation when the crystals have attained a high point-defect concentration by deformation. The absorption spectra of such color centers were measured and compared with x-ray-determined degrees of deformation. The formation and thermal annealing of the defects required for the origin of color centers was quantitatively investigated. It was established that at least two different color centers occur, and their concentration ratio depends on the thermal pretreatment of the deformed calcite samples. (tr-auth)

52871 CRYSTAL STRUCTURES OF ANHYDROUS RARE-EARTH CHLORIDES. Morosin, B. (Sandia Lab., Albuquerque, N. Mex.). J. Chem. Phys., 49: 3007-11(Oct. 1, 1968).

The crystal structures at 298°K of $LaCl_3$, $NdCl_3$, $EuCl_3$, and $GdCl_3$ have been refined by full-matrix least-squares methods using three-dimensional MoKα intensity data. These isomorphous compounds belong to the UCl_3-$P6_3/m$ structure type; metal atoms occupy symmetry sites at ($\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$) and chloride ions lie on mirror sites at (x, y, $\frac{1}{4}$) with $x \cong 0.39$ and $y \cong 0.30$. Standard deviations of the interatomic separations do not exceed 1 part in 1000. (auth)

52872 THE DE HAAS–VAN ALPHEN EFFECT AND THE FERMI SURFACE OF TUNGSTEN. Girvan, R. F.; Gold, A. V.; Phillips, R. A. (Iowa State Univ., Ames). J. Phys. Chem. Solids, 29: 1485-1502(Sept. 1968).

The de Haas–van Alphen effect in tungsten has been studied in detail using large impulsive magnetic fields, and the frequencies have been determined to high accuracy with the aid of digital data recording, digital analysis, and dynamic calibration of the entire apparatus. These improvements in experimental technique have resulted in the detection of several new frequency branches not previously reported. A quantitative description of all sheets of the Fermi surface is given in terms of simple analytical functions, and this geometrical model is in excellent agreement with the observed angular variations of the de Haas–van Alphen frequencies. In most respects, the model surface is found to be quite similar to that deduced by Loucks (1965 and 1966) from first-principles relativistic band calculations, and the predictions of the empirical model are compared with the results of other experiments relating to the Fermi surface. (auth) (UK)

52873 MOESSBAUER STUDIES OF THE CUBIC LAVES IRON–RARE-EARTH INTERMETALLIC COMPOUNDS. Bowden, G. J.; Bunbury, D. St. P.; Guimaraes, A. P.; Snyder, R. E. (Univ. of Manchester, Eng.). J. Phys., C (London), 1: 1376-87(Oct. 1968).

The Moessbauer effect in ^{57}Fe was used to study the hyperfine fields at the iron sites in polycrystalline samples of the cubic Laves AFe_2 intermetallics, where A is Ce, Sm, Gd, Tb, Dy, Ho, Er, Y or Zr. The ^{57}Fe spectra in the Tb, Er, Y and Zr intermetallics can be analyzed in terms of two distinct six-line ^{57}Fe patterns, whereas those in Dy and Ho exhibit only one pattern. This is shown to be consistent with [111] and [001] directions of magnetization, respectively. The cases of Sm, Gd, and Ce are found to be more complicated. An analysis of the results is attempted on the basis of a simple model in which the direction of magnetization is determined by the crystalline electric torques acting on the rare earth ions. An estimate is made of the magnetic dipole contributions to the local internal fields. It is found that this leads to a magnetic interaction which is dependent on the iron site and on the direction of magnetization. The hyperfine fields at the ^{57}Fe and ^{161}Dy sites in $DyFe_2$ were also followed as a function of temperature. This parallels other work done on $TmFe_2$ and allows a comparison of the rare earth–iron exchange in these intermetallics. (auth)

52874 THE INFLUENCE OF POINT DEFECTS ON THE LATTICE PARAMETERS OF ANNEALED AND IRRADIATED Cu, Mo, AND Ni. Malinenko, I. A.; Shivrin, O. N. (Petrozavodsk State Univ., USSR). Fiz. Metal. Metalloved., 26: 184-6 (July 1968). (In Russian).

Changes in lattice parameters of technically pure Ni, Mo, and Cu (impurities not exceeding 0.1%) were studied using specimens irradiated with 1.3-MeV γ rays at the doses 10^3, 10^4, and 10^5 R at 30°C and Ni and Mo annealed in water at 1300°C and Cu at 1000°C. The order of error of the measurements was about 0.01%. The graphical data on radioinduced changes revealed increased lattice parameters in all irradiated specimens. However, with increased doses, the parameters stabilized and even reduced in comparison with the maximum values. (R.V.J.)

52875 GAMMA IRRADIATION COLOR CENTERS IN Na_2O–Al_2O_3–GeO_2 GLASSES. Bettinali, Carlo (Univ., Rome); Bonetti, Giovanni. Z. Phys. Chem. (Frankfurt), 61: 37-46(Aug. 1968).

The induced gamma-radiation color centers have been studied in 15 glasses of the $Na_2O-Al_2O_3-GeO_2$ system by means of electron spin resonance absorption, optical absorption, and thermoluminescence. The composition of the glasses and the different structural units determine the types of centers produced. Different coordinations of Ge and Al have been related to the radiation centers studied. (auth)

52876 ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED ROCHELLE SALT SINGLE CRYSTAL. II. ANALYSIS OF CENTER NO. 1. Suzuki, Ikuo; Abe, Ryuji (Nagoya Univ., Japan). J. Phys. Soc. Jap., 25: 783-8(Sept. 1968).

The structure of a radical in gamma-irradiated Rochelle salt, which was named center No. 1 by Moulton and Moulton was studied by the electron spin resonance spectra at X-band frequency. The principal values of hyperfine tensors for the two protons were determined to be 5.4, −0.0, and −0.9 gauss, and 4.8, 3.4, and −4.0 gauss. The principal values of g-tensor were also determined to be 2.0049, 2.0039, and 2.0024. From the informations obtained from the hyperfine coupling tensors and g-tensor, the structure of center No. 1 was proposed to be OOCC(OH)CH · (OH)COO which was formed by the breaking of C-H bond in the tartrate molecule. It is identical with the one of center No. 3 in the chemical composition, but different in the geometrical structure. (auth)

52877 DE HAAS–VAN ALPHEN EFFECT AND FERMI SURFACE IN NIOBIUM. Scott, G. B.; Springford, M.; Stockton, J. R. (Univ. of Sussex, Brighton, Eng.). Phys. Lett., 27A: 655-6 (Oct. 7, 1968).

De Haas–van Alphen oscillations have been investigated in niobium and are discussed in terms of a model for the Fermi surface proposed by Mattheiss. (auth)

52878 METAMAGNETIC BEHAVIOR OF EuSe. Kuznia, C.; Kneer, G. (Forschungslaboratorium, Munich). Phys. Lett., 27A: 664-5(Oct. 7, 1968).

The temperature and field dependences of two metamagnetic transitions in EuSe have been investigated. (auth)

52879 ENERGY STRUCTURE IN THE AXIAL CHANNELING OF 30-keV PROTONS THROUGH GOLD. Chadderton, L. T.; Anderson, M. G. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Lett., 27A: 665-6(Oct. 7, 1968).

Structure which appears in energy-analyzed spectra for the transmission of 30-keV protons through a thin crystal of gold is ascribed to selection of discrete channeling orbits for the [110] axial channel. (auth)

52880 NUCLEAR-MAGNETIC-RESONANCE FREE INDUCTION DECAY IN A SYSTEM OF SEVERAL SPECIES. Demco, D. (Univ., Cluj). Phys. Lett., 27A: 702-3(Oct. 7, 1968).

A theoretical formula for the free induction decay in a system of several species in a rigid lattice is derived. Dipolar and small exchange interactions between spins are taken into account. (auth)

52881 ELECTRICAL STUDIES OF NEUTRON-IRRADIATED p-TYPE SILICON: DEFECT STRUCTURE AND ANNEALING. Stein, H. J. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys., 39: 5283-7(Oct. 1968).

Defects produced in float-zone and crucible-grown p-type silicon by neutron irradiation at 76°K were investigated, using electrical conductivity and Hall-effect measurements. The behavior of the neutron-produced defects is independent of the crystal growth and exhibits an illumination dependence similar to that previously observed in n-type silicon and attributed to the presence of defect clusters. The neutron-produced changes in the electrical properties of p-type silicon at 76°K are therefore ascribed to defect clusters. The annealing loss of the light-sensitive defects occurs in diffuse stages between 150 and 550°K. The largest stage is observed between 150 and 240°K. A major fraction of the hole-mobility annealing parallels the annealing for the light-sensitive defects, and suggests that the mobility change caused by defect

clusters is significantly larger than that caused by isolated defects formed from cluster dissociation. The most apparent crystal-growth-dependent annealing is observed between 540° and 620°K, where a reverse annealing occurs in the hole-removal rate for crucible-grown, but not for float-zone, silicon. The fractions of the neutron-produced decreases in hole concentration and mobility which remain after 700°K annealing are, respectively, ~0.1 and 0.01 for float-zone, and ~0.25 and 0.1 for crucible-grown silicon. (auth)

52882 MAGNETIC AND MAGNETO-OPTIC PROPERTIES OF EuO FILMS DOPED WITH TRIVALENT RARE-EARTH OXIDE. Ahn, K. Y.; McGuire, T. R. (IBM Watson Research Center, Yorktown Heights, N. Y.). J. Appl. Phys., 39: 5061-5(Oct. 1968).

The ferromagnetic Curie temperature of EuO films has been increased by selective doping with trivalent rare-earth oxides. The electrical resistivity, which depends upon the temperature and has a broad peak at ≈100°K, decreases markedly to $\approx 10^{-1}\ \Omega \cdot$ cm with doping. A typical ferromagnetic Curie temperature, determined from magneto-optic measurements in zero applied field, is ~135°K. Maximum longitudinal Faraday rotation occurs at 0.65 μ with a specific rotation of $+1 \times 10^5$ deg/cm for an incidence angle of 20 deg. At 0.84 μ the Faraday rotation reverses sign and reaches a negative maximum at 0.93 μ. The longitudinal Kerr rotation also has two maxima at 0.58 μ and 0.83 μ with double rotations of ≈4°. The transverse Kerr effect depends on the wavelength in the same manner and has maximum values of +0.4 and −0.3, respectively. There is a strong optical absorption band centered at 0.6 μ (at 300°K) with $\alpha \approx 1.2 \times 10^5\ cm^{-1}$ which shifts toward longer wavelengths at lower temperatures accompanied by a small decrease in α. An additional absorption band centered around 0.4 μ with amplitude less than 10% of the main absorption peak appears as a result of doping. Quasistatic switching measurements show that the coercive force depends strongly upon the stress in films arising from the difference in thermal expansion coefficients of EuO and substrates. H_c is typically 120 and 60 Oe on fused quartz and 0080 glass, respectively, with remanence of ~0.7. Results of the transport, magnetic, magneto-optical, and optical properties are discussed in terms of indirect exchange via conduction electrons. (auth)

52883 MAGNETIC CHARACTERISTICS OF 2–17 LANTHANIDE-NICKEL COMPOUNDS. Carfagna, Paul D.; Wallace, W. E. (Univ. of Pittsburgh). J. Appl. Phys., 39: 5259-62(Oct. 1968).

Magnetic characteristics of nine compounds represented by the formula Ln_2Ni_{17} (Ln = Y or a lanthanide) are reported. The Y, Sm, and Lu compounds are ferromagnetic; the others are ferrimagnetic. Curie temperatures range from 601 to 641°K. The nickel moment is 0.27 μ_B, which is in very close agreement with 0.25 μ_B, the value expected if all Ln valence electrons are transferred into the Ni 3d band. Magnetization of the Y_2N_{17} and Lu_2Ni_{17} compounds is lost in two stages as temperature is increased. Ferrimagnetism of heavy lanthanide compounds is indicated by the magnitude of their saturation moments and the form of the magnetization-temperature curves. The magnetic coupling is the same as that observed in similar and related Ln–Co and Ln–Fe compounds, i.e., the Ln–Ni coupling is antiferromagnetic and ferromagnetic for heavy and light lanthanides, respectively. From the Curie temperature it is inferred that the Ni–Ni interaction is dominant. This is in contrast with the situation in Ni-containing Laves and Haucke phases, in which the Ln–Ln interaction is dominant. (auth)

52884 ULTRASONIC ATTENUATION IN THE HELICAL SPIN STATE OF THE RARE-EARTH METALS. Tachiki, M. (Osaka Univ.); Levy, M.; Kagiwada, R.; Lee, M. C. Phys. Rev. Lett., 21: 1193-5(Oct. 14, 1968).

Form-factor measurements were made for the complexes of levels at excitations near 16 and 19 MeV for values of three-momentum transfer ranging from 190 to 710 MeV/c. Form-factor measurements were also made for the T = 1, 1^+ level at 15.1 MeV. Upper and lower limits on the form factor for the giant resonance in ^{12}C in the same three-momentum transfer range are also given. The data were analyzed in terms of the particle-hole model. It was found that the simple particle-hole model successfully accounts for the gross features of the electron inelastic scattering data in the range of excitation from 12 to 32 MeV. (D.C.W.)

52885 NEUTRON-DIFFRACTION STUDY OF THE ANTIFERROMAGNETISM OF URANIUM MONOARSENIDE. Williams, J. H.; Heaton, L.; Campos, F. (Argonne National Lab., Ill.). J. Phys. Chem. Solids, 29: 1702-3(Sept. 1968).

Recent susceptibility–temperature measurements [Trzebiatowski, W., et. al., Bull. Acad. Pol. Sci., 12: 687(1964)] of uranium monoarsenide exhibit a maximum at 128°K suggestive of an antiferromagnetic transition. Neutron-diffraction patterns of polycrystalline UAs were obtained at ambient and liquid-nitrogen temperatures. Antiferromagnetic ordering has been confirmed by the presence of temperature-dependent diffraction peaks in the latter pattern. (auth) (UK)

52886 FARADAY ROTATION STUDIES OF F CENTRES IN ALKALINE EARTH OXIDES. Bessent, R. G. (AERE, Harwell, Eng.); Cavenett, B. C.; Hunter, I. C. J. Phys. Chem. Solids, 29: 1523-30(Sept. 1968).

It has been shown by Kemp and others, using Faraday rotation, that the 3.7-eV optical absorption band in neutron-irradiated calcium oxide is due to the F centre. Faraday rotation was used to identify the F bands at 3.0 eV in strontium oxide and 2.0 eV in barium oxide. By making careful measurements on samples of optical density less than 2 and using the method of moments analysis values of λ, the effective spin-orbit coupling constant were derived for the first excited states of the F centres of −24 cm^{-1} for calcium oxide, −185 cm^{-1} for strontium oxide, and −265 cm^{-1} for barium oxide. These values are in reasonable agreement with those calculated from a simple model of the first excited state of the F centre. (auth) (UK)

52887 NUCLEAR SPIN RELAXATION IN BERYLLIUM METAL. Alloul, H.; Froidevaux, C. (Laboratoire de Physique de Solides, Orsay, France). J. Phys. Chem. Solids, 29: 1623-37(Sept. 1968).

The quadrupole-split NMR spectrum of ^9Be nuclei ($I = 3/2$) in pure Be metal has been studied by pulse methods. The free induction decay (FID) is modulated: the frequency of modulation gives a new measurement of the quadrupole coupling constant $e^2qQ/h = 57 \pm 1$ kHz. Analysis of the FID shows also that the central line and satellites are non-gaussian. Their second moments agree with the dipolar values in an annealed sample. If the sample is not annealed the satellites are broadened. The width of the distribution of the electric field gradient has been deduced. The spin echo envelope is also modulated. Previous calculations of echoes in quadrupole-split systems are verified for this particular case. Spin–lattice relaxation time T_1 measurements show that T_1T is constant from 1.5 to 300°K. The value of this constant depends on the state of annealing of the sample. This observation shows that the electronic structure of Be is very sensitive to slight changes of the crystal structure. After a long anneal $T_1T = (1.85 \pm 0.10) \times 10^4$ sec °K. (auth) (UK)

52888 COMMENT ON DISLOCATION VELOCITY MEASUREMENTS IN HIGH PURITY MOLYBDENUM. Stein, D. F. (Univ. of Minnesota, Minneapolis). Scr. Met., 2: 555-6(Oct. 1968).

Prekel, Lawley, and Conrad (Acta Met. 16, 337(1968)) measured the dislocation mobility in Mo as a function of temperature. The temperature dependence of the stress to maintain a dislocation velocity of 10^{-3} cm/sec from their data is compared to that predicted by the Rajnak–Dorn analysis of the Peierls–Nabarro force. From 78 to 300°K, the observed change is 3 kg/mm^2, while the prediction is 40 kg/mm^2. The disagreement indicates that the Peierls–Nabarro mechanism is not rate-controlling. (D.L.C.)

52889 SPECIFIC HEATS OF THE COMPOUNDS YCu AND YAg BETWEEN 1.3 AND 5°K. Pierre, Jacques (CNRS, Grenoble, France). Compt. Rend., Ser. A and B, 267: 287-9(July 22, 1968). (In French).

The density of states at the Fermi level is approximately three times that predicted by a free-electron model. (tr-auth)

52890 PARAMAGNETIC CENTERS IN γ-IRRADIATED ANTHRACENE SINGLE CRYSTALS. Inoue, Toshiharu (Sumitomo Chemical Co., Ltd., Osaka). J. Phys. Soc. Jap., 25: 914(Sept. 1968).

Anthracene crystals were irradiated with ^{60}Co γ radiation of 10^7 to 10^8 R in vacuum at room temperature. Results of measurements on their ESR and dichromic optical absorption spectra are reported. (M.O.W.)

52891 MAGNETIC PROPERTY OF THE COMPOUND DyAu. Kaneko, Takejiro (Tohoku Univ., Sendai). J. Phys. Soc. Jap., 25: 905(Sept. 1968).

The variation of susceptibility of the compound DyAu with temperature and its magnetization under magnetic field up to 80 kOe at 4.2°K were measured. (M.O.W.)

52892 SPIN–ORBIT COUPLING AND STRESS SPECTRA OF TRIGONAL COLOUR CENTRES IN MAGNESIUM OXIDE. Ludlow, I. K. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London), 1: 1194-1204(Oct. 1968).

Two independent zero-phonon lines were seen at 6420 and 6490 Å in the absorption spectra of single crystals of magnesium oxide which had been neutron-irradiated and thermally annealed. The 6490-Å line was split by 9 cm^{-1} owing to the spin–orbit interaction. The polarization spectra of the two color centers were examined under uniaxial stresses of up to 50 kg mm^{-2} and were in agreement with the theoretical splitting patterns for electric

dipole transitions in trigonal centers. Models for the centers include the analogue of the R center in the alkali halides, and an R center with a trigonally disposed cation vacancy. (auth) (UK)

52893 LOW-ENERGY DEPTH DISTRIBUTIONS IN Pt, Al, AND KCl AS OBTAINED BY SPUTTERING. Kelly, Roger (McMaster Univ., Hamilton, Ont.). J. Appl. Phys., 39: 5298-5303 (Oct. 1968).

Depth-distribution measurements have been made by means of the sputtering technique with Pt, Al, and KCl, in all cases following low-energy labelings with Kr containing ^{85}Kr. The observed values of R_m, the median or 50% range, were with Pt 14 Å at 3 keV and 59 Å at 9 keV; with Al they were 56 Å at 4 keV and 101 Å at 10 keV; and with KCl they were 9 Å for Tesla energies, 38 Å at 2 keV, 67 Å at 4 keV, and 105 Å at 10 keV. It was possible to show that gas sputtering and related effects probably did not play an important role in the experiments. Thus, the ranges (a) were, in general, comparable to those obtained using electrochemical techniques, (b) were independent of the sputtering energy (shown with KCl), and (c) were in a similar proportion to each other as required from dissolution experiments (shown with KCl). (auth)

52894 TEMPERATURE DEPENDENCE OF F-CENTER ABSORPTION IN KBr AND NaBr. Jacobs, P. W. M.; Menon, A. Krishna (Univ. of Western Ontario, London). J. Chem. Phys., 49: 2920-6(Oct. 1, 1968).

The absorption due to F centers in x-irradiated KBr and NaBr has been measured over a wide range of temperatures from 4 to 370°K. In NaBr (which is exceedingly difficult to color) there is also formed a well-isolated M band without the usual difficulty of overlapping R bands and so the temperature dependence of the shape of this M band could also be determined accurately. The difficulty of the overlapping K band has been dealt with in two ways: by Gaussian plots of the untreated data (after background subtraction) and by a computer resolution of the F and K bands. The latter calculations confirm the asymmetry of the K band. The half-widths of the F and M bands obey the usual formula $H(T) = H(0)\,[\coth \hbar\omega_g/2kT]^{\frac{1}{2}}$ and from the temperature dependence of the half-widths, values of the effective ground-state frequency ν_g were obtained. To what extent this represents a genuine local mode remains unresolved. There is some evidence for structure in the K band at low temperatures. (auth)

52895 EFFECT OF CONVERTED ISOMERIC TRANSITION IN ^{125m}Te ON THE MOESSBAUER EMISSION SPECTRA IN SOME Te COMPOUNDS. Lebedev, V. A.; Lebedev, R. A.; Babeshkin, A. M.; Nesmeyanov, A. N. Vestn. Mosk. Univ., Ser. II. Khim., No. 4, 16-19(July-Aug. 1968). (In Russian).

New sources for the nuclear γ-resonance experiments with ^{125}Te were tested. β-$^{125m}TeO_3$ was found to have a recoilless fraction of γ rays twice as much as one in the case of $Pb^{125m}Te$ or ^{125}Sb in Cu-matrix. $H_6{}^{125m}TeO_6$ and $Na_2H_4{}^{125m}TeO_6$ sources gave abnormal forms of emission spectra which were interpreted in terms of hot-atoms chemistry. (auth)

52896 METAMAGNETIC PROPERTIES OF THE COMPOUNDS Tb_3Al_2 AND Dy_3Al_2. Barbara, Bernard; Becle, Christian; Feron, Jacques-Louis; Lemaire, Remy; Pauthenet, Rene (CRNS, Grenoble, France). Compt. Rend., Ser. A and B, 267: 244-7(July 22, 1968). (In French).

The compounds Tb_3Al_2 and Dy_3Al_2 have a transition between a ferromagnetic order and an antiferromagnetic or non-colinear order. This transition seems connected to important effects of the crystalline field. (tr-auth)

Theoretical Physics

Refer also to abstracts 52493, 53016, and 53071.

52897 (AD-662640) RESEARCH ON STATISTICAL MECHANICS. Final Scientific Report, April 1, 1962–October 30, 1967. Mazur, Peter (Leiden Rijksuniversiteit (Netherlands). Instituut-Lorentz voor Theoretische Natuurkunde). 9p. (AFOSR-67-2779). CFSTI.

Research has been performed and completed on Brownian motion in systems of finite size; the statistical-mechanical theory of Brownian motion, both classical and quantum-mechanical; the statistical-mechanical derivation of Maxwell's Equations; and the relativistic dynamics of polarized systems. (USGRDR)

52898 ANGULAR MOMENTUM. SECOND EDITION. Brink, D. M.; Satchler, G. R. Oxford, Clarendon Press, 1968. 170p. 28s.

The quantum theory of angular momentum is treated under the following main headings: symmetry in physical laws; representations of the rotation group; coupling angular momentum vectors, and transformation theory; tensors and tensor operations; matrix elements of tensor operators; applications to physical systems; graphical methods in angular momentum. Appendixes cover: 3-j and Clebsch–Gordan coefficients; 6-j symbols, Racah coefficients; 9-j symbols or X-coefficients; spherical harmonics; rotation matrix elements; and tensors and their matrix elements. (UK)

52899 ANGULAR SYMMETRY OF THE 2-MATRIX. Garrod, Claude (Univ. of California, Davis). Contract AT(11-1)-Gen-10. Phys. Rev., 172: 173-6(Aug. 5, 1968). (UCD-CLN-89).

For a system of N spinless particles in a state of definite angular momentum L with definite z component M, the rotational symmetry properties of the two-particle density matrix are obtained in a completely explicit fashion. Also studied is the 2-matrix associated with an equally weighted (unpolarized) ensemble of the various M states for a given L. (auth)

52900 RELATION BETWEEN THEORY OF ELEMENTARY LENGTH AND QUANTUM THEORY. Jordan, P. Commun. Math. Phys., 9: 279-92(1968). (In German).

The idea is discussed that a generalization of quantum mechanics (seeming to be necessary) might require (a) a new concept about possibilities of microphysical measurement; (b) new mathematical structures as tools of theoretical description. Perhaps, (a) could have the form that in the general case of the new theory the measurement of an observable u can be performed only so far as to measure in a statistical ensemble the mean value $\bar{u}$ and the mean quadratic deviation $\overline{(\Delta u)^2} = \overline{u^2} - \bar{u}^2$. Perhaps, (b) could be fulfilled by a new class of nonassociative, commutative algebras. Certainly the following is only a first attempt, putting forward more questions than answers. (auth)

52901 ON THE DERIVATION OF THE SCHROEDINGER EQUATION IN A RIEMANNIAN MANIFOLD. Parthasarathy, K. R. (Univ. of Manchester, Eng.). Commun. Math. Phys., 9: 303-12(1968).

Under certain conditions it is shown that the kinetic part of the dynamical operator of a quantum mechanical system with a Riemannian manifold as configuration space is the Laplace–Beltrami operator. (auth)

52902 STATISTICAL MECHANICS OF QUANTUM SPIN SYSTEMS. III. Lanford III, Oscar E. (Univ. of California, Berkeley); Robinson, Derek W. Commun. Math. Phys., 9: 327-38(1968).

In the algebraic formulation the thermodynamic pressure, or free energy, of a spin system is a convex continuous function P defined on a Banach space B of translationally invariant interactions. It is proved that each tangent functional to the graph of P defines a set of translationally invariant thermodynamic expectation values. More precisely each tangent functional defines a translationally invariant state over a suitably chosen algebra A of observables, i.e., an equilibrium state. Properties of the set of equilibrium states are analyzed and it is shown that they form a dense set in the set of all invariant states over A. With suitable restrictions on the interactions, each equilibrium state is invariant under time translations and satisfies the Kubo–Martin–Schwinger boundary condition. Finally it is demonstrated that the mean entropy is invariant under time-translations. (auth)

52903 A SYSTEMATIC STUDY AND APPLICATIONS OF THE EIGENVALUE PROBLEM FOR QUADRATIC HAMILTONIANS. Roberts, James Lannis. Baton Rouge, La., Louisiana State Univ. and Baton Rouge, La., Agricultural and Mechanical Coll., 1968. 95p.

Thesis.

A systematic procedure is developed for solving the eigenvalue problem for a broad class of Hamiltonian operators containing no terms higher than quadratic in generalized coordinates and their conjugate momenta. The development is oriented toward practical applications in the area of the many-body problem. The procedure accomplishes a canonical reduction of such a Hamiltonian to the form of the Hamiltonian for a collection of noninteracting bosons, with the eigenvalues of the Hamiltonian expressed in terms of the solutions to a single secular equation. Application of the results to systems of interacting identical bosons is discussed, including a presentation of a useful calculational technique. The procedures developed are illustrated by detailed treatments of two specific problems of interest in physics. The first problem considered is an exactly solvable separable potential model of particle field theory. This problem consists of the description of a collection of light bosons interacting with an infinitely heavy boson via a simple separable potential. Interest in this problem centers on its use as a test case for approximation techniques to be used on more complicated systems. The second and more realistic problem investigated is the polaron problem of solid-state physics. This problem involves the description of the motion of a single conduction electron within an ionic solid. The polaron consists of

the conduction electron together with its self-induced polarization field. The polaron problem is of interest not only because of its value in solid-state physics, but also because it, too, is useful as a testing ground for approximation techniques. Finally, broad applicational aspects of the procedures developed are discussed. (Disser. Abstr.)

52904 A CLASSICAL INTERPRETATION OF THE SPIN–POLARIZATION EFFECT OF ELECTRONS MOVING IN A UNIFORM MAGNETIC FIELD. Storck, E. (Univ., Munich). Phys. Lett., 27A: 651(Oct. 7, 1968).

The spin–polarization effect of electrons in a magnetic field is explained as the retroaction of the emission of a top oscillating on account of an elementary angular and magnetic momentum. (auth)

52905 SEPARABLE POTENTIAL HAMILTONIANS AND THE INTERACTION OF LIGHT WITH MATTER. Trubatch, Sheldon L. Waltham, Mass., Brandeis Univ., 1968. 261p. Thesis.

Several models describing the interaction of a nonrelativistic recoiling particle with a quantized field were investigated in order to develop nonperturbative approximation techniques for the treatment of recoil-induced nonlinearities in the coupling. The dipole approximation was also applied to these problems in order to study the divergence difficulties associated with point interactions. Because many of the techniques used are based on the diagonalization of quadratic forms, the theory of linear, homogeneous, canonical transformations is extensively developed and physical quantities are expressed in terms of the diagonalizing bases. As a by-product, a class of nonlinear integral equations is reduced to Fredholm form. Insight into the point interaction divergence difficulties is gained by exhaustively exploring the Wentzel pair theory (which is the dipole approximation to the full recoiling pair theory) and the dipole approximate form of non-relativistic quantum electrodynamics. Attempts to isolate infinite quantities in a cutoff-induced resonance are shown to fail in all dimensions as does generalized frequency renormalization. The full recoil pair theory is treated in the general harmonic approximation, which is a formal method of diagonalizing the maximum quadratic piece of any Hamiltonian and is, thus, equivalent to the suppression of virtual pair production in the first order of perturbation theory. A general iteration scheme which breaks the nonlinearity of the full diagonalizing equations is displayed. The first iterate leads to a reduction of all divergences from linear to logarithmic. Intermediate coupling techniques which use a small number of modes are coupled with Bargmann space techniques but are found to lead to intractable minimization problems. (Disser. Abstr.)

52906 DUHAMEL'S PRINCIPLE IN THE NONSTATIONARY RADIATION FIELD. Matsumoto, Masamichi (Kyoto Univ.). J. Math. Anal. Appl., 21: 445-57(Feb. 1968).

The nonclassical radiation field due to arbitrary incident radiation is expressed by an integration of the radiation field due to incident radiation in a specified direction. Duhamel's principle for a time-dependent radiation field in an inhomogeneous atmosphere of finite or semi-infinite thickness is discussed. The medium in the atmosphere is assumed independent of time, but the incident radiation is nonstationary. Considerations of fundamental equations start with a finite, plane-parallel, nonemitting and isotropically scattering atmosphere of arbitrary stratification, with radiation falling on the upper and lower surfaces. A modified Milne's integral equation is solved. For the internal radiation field due to nonstationary incident radiation, Duhamel's principle is stated in the form of 2 theorems. In these expressions the radiation fields $I_0(t-t', z,\mu;\mu)$ and $I_1(t-t',z,\mu;\mu')$ are shown to be those at time t at depth z in direction $\cos^{-1}\mu$, due to incident radiation at time t' in direction $\cos^{-1}\mu'$. For the stationary radiation field Duhamel's principles for a finite and semi-infinite atmosphere hold respectively under the conditions $\sigma/\rho \leq 1$ and $\sigma/\rho < 1$ (ρ and σ are the monochromatic volume attenuation and scattering coefficient, respectively). For the nonstationary radiation field this difference disappears. (BBB)

52907 POLARIZATION OF SYNCHROTRON RADIATION. Mychelkin, E. G. (Astrophysics Inst., Alma-Ata, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 326-33(Sept.-Oct. 1968).

Translated from Astron. Zh., 45: 408-18(Mar.-Apr. 1968).

The radiation from a charge moving along a spiral trajectory in a magnetic field at an arbitrary velocity of constant magnitude is calculated by a method involving no approximations. The radiant power and intensity are considered separately; for each, the spectral angular distribution, the angular distribution summed over all harmonics, and the integrated values of the components of linear polarization are obtained, as well as the relative elliptical polarization of the total radiation. The results for the radiant power are given in two inertial coordinate systems — the laboratory system and a frame moving together with the charge along the field at a velocity $u = v_{||}$. The treatment is based on classical relativity theory. (auth)

52908 POLARIZATION OF MONOCHROMATIC LIGHT IN RIEMANN SPACE. Kichenassamy, S. (CNRS, Paris). Ann. Inst. Henri Poincare, Sect. A, 8: 253-68(1968). (In French).

Additional remarks concerning the propagation of null electromagnetic fields and a critical appraisal of Robinson's theorem are given along with a definition of light polarization types by means of generalized Stokes' parameters and a study of the propagation of these types. (auth)

52909 SCATTERING OF CHARGED PARTICLES BY RANDOM ELECTROMAGNETIC FIELDS. Hasselmann, K. (Institut fuer Schiffbau, Hamburg); Wibberenz, G. Z. Geophys., 34: 353-88 (1968).

A general, relativistic formalism for particle scattering by random electromagnetic fields is developed in the weak-interaction approximation. The scattering is described by a Fokker–Planck equation, the coefficients of which are derived as linear spectral integrals over an infinite set of resonance surfaces. The formulas are evaluated explicitly for three field models. The theory is applied to the spatial diffusion parallel to the mean field, the equilibrium pitch-angle distribution, and Fermi acceleration processes. Detailed comparisons with observations will be given in subsequent papers. (auth)

52910 ONE- AND TWO-CENTER EXPANSIONS OF THE BREIT–PAULI HAMILTONIAN. Fontana, Peter R. (Univ. of Michigan, Ann Arbor. Univ. of Wisconsin, Madison); Meath, William J. J. Math. Phys. (N. Y.), 9: 1357-64(Sept. 1968).

The orbit–orbit, spin–spin, and spin–orbit Hamiltonians of the Breit–Pauli approximation are expressed in terms of irreducible tensors. One- and two-center expansions are given in a form in which the coordinate variables of the interacting particles are separated. In the one-center expansions of the orbit–orbit and spin–orbit Hamiltonians the use of the gradient formula reduces some of the infinite sums to finite ones. Two center expansions are discussed in detail for the case of nonoverlapping charge distributions. The angular parts of the matrix elements of these Hamiltonians are evaluated for product wave functions. (auth)

52911 RADIATION SELF-POLARIZATION OF THE SPIN OF ELECTRONS IN MOTION ALONG THE SPIRAL IN THE MAGNETIC FIELD. Sokolov, A. A.; Ternov, I. M.; Bagrov, V. G.; Gal'tsov, D. V.; Zhukovskii, V. Ch. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 5, 13-18(1968). (In Russian).

The effects of the self-polarization of the spin during electron motion along the spiral in the magnetic field were investigated. The different possibilities for the description of the spin properties of the electron were considered. (tr-auth)

52912 SOME VARIATIONAL PRINCIPLES FOR INTEGRAL EQUATIONS. Robinson, P. D.; Arthurs, A. M. (Univ. of York, Eng.). J. Math. Phys. (N. Y.), 9: 1364-8(Sept. 1968).

Complementary variational principles are developed for the solution of Fredholm integral equations with symmetric positive-definite kernels. In particular, the theory is applied to linear equations of the type $\varphi(r) = f(r) + \lambda \int K(r,s)\varphi(s)ds$, and bounds are obtained for $\int f\varphi dr$. When λ is negative, the bounds are complementary upper and lower ones. When λ is positive, the bounds are one-sided, but an improvement is made on a result of Strieder and Prager [J. Math. Phys., 8: 514(1967)]. A condition given by these authors for the existence of bounds does not seem to be strictly necessary, and alternative conditions are derived. Systematic improvement of bounds by iterative and scaling procedures is discussed. (auth)

52913 ANTISYMMETRIC PROJECTION IN THE APPROXIMATION OF NO SPIN–ORBIT COUPLING. Sullivan, John J. (Univ. Catolica, Rio de Janeiro). J. Math. Phys. (N. Y.), 9: 1369-74(Sept. 1968).

The explicit form of the projection operator for constructing antisymmetric wave functions for N fermions in the approximation of no spin–orbit coupling is developed. Projection is applied within the one particle approximation. It is shown that if the orbitals associated with the minority spin can be completely expanded in terms of the orbitals associated with the majority spin, then the projected Hartree–Fock scheme is completely equivalent to unprojected Hartree–Fock theory. In the unrestricted case, deviations from this condition are not expected to be large, and integral properties such as energies calculated in the projected scheme should not be significantly different from unprojected results. However, for such properties as spin density at the nucleus in atoms or ions with nominally closed s shell, there may be significant differences between projected and unprojected schemes. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 52949.

Electromagnetic

52914 DIFFERENTIAL CROSS SECTIONS IN ETA PHOTOPRODUCTION FROM 0.8 TO 1.45 GeV. Bloom, E. D.; Heusch, C. A.; Prescott, C. Y.; Rochester, L. S. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 21: 1100-3(Oct. 7, 1968).

The cross section for the process $\gamma p \rightarrow p\eta$ was studied from 0.8- to 1.45-GeV incident photon energy at center-of-mass angles from 50 to 90°. The data cover a range of energies well beyond previous measurements. The results will aid in the study of $I = \frac{1}{2}$ nucleon isobars. (auth)

52915 COSMIC-RAY MUON STUDIES UNDERGROUND. Cottrell, Don Marion. Seattle, Univ. of Washington, 1967. 68p. Thesis.

The inelastic scattering of high-energy muons from emulsion nuclei was measured using the beam of high energy penetrating muons underground. Stacks of Ilford G-5 emulsion were manufactured, exposed, and developed underground at several locations. Altogether 429 cubic centimeters of nuclear emulsion were scanned for nuclear interactions. Within this scanned volume a total of 426 nuclear disintegrations were found of which 104 were classified as muon scattering events. The cross section for muon interactions was found to depend upon depth, increasing from 2.87 microbarns under 3100 grams of rock to 8.26 microbarns under 7800 grams of rock. The angular distribution of the incident muon flux was measured and found to also depend upon depth, being more strongly peaked toward the vertical at greater depth. The cross section for muon scattering increases with zenith angle, as does the relative abundance of high energy muons. (Disser. Abstr.)

52916 SCATTERING OF POSITIVE AND NEGATIVE MUONS FROM ELECTRONS AT ENERGIES AROUND 6 GeV AND 11 GeV. Kirk, Thomas Bernard Walter. Seattle, Univ. of Washington, 1967. 128p. Thesis.

The scattering of positive and negative high energy muons from electrons has been measured and compared. An electromagnetic shower counter was employed in determining the scattered electron energy. The laboratory energy transfer to the electron varied from 100 MeV to 6.5 GeV. In this range no asymmetry was observed within the ±10% experimental resolution. The theoretical μ-e cross sections (without radiative corrections) were verified to an accuracy of ±30%. A systematic uncertainty in calibrating the shower counter energy response precluded a check of the radiative corrections (estimated to be 10–20%). (Disser. Abstr.)

52917 TEST OF TIME-REVERSAL INVARIANCE IN ELECTROPRODUCTION INTERACTIONS USING A POLARIZED PROTON TARGET. Chen, J. R.; Sanderson, J.; Appel, J. A.; (and others) (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 21: 1279-82(Oct. 21, 1968).

Electrons were scattered inelastically from an alcohol-water target containing protons polarized normal to the scattering plane. Scattered-electron energies corresponding to the excitation of the 1236-, 1512-, and 1688-MeV nucleon resonances were observed at four-momentum transfers between 0.2 and 0.7 $(GeV/c)^2$. A search was made for changes in the intensity of the scattered electrons as the target polarization was reversed. None was seen. (auth)

52918 NEGATIVE PION PRODUCTION FROM NEUTRONS BY POLARIZED γ RAYS. Nishikawa, T.; Hiramatsu, S.; Kimura, Y.; Kobayashi, M.; Kondo, K.; Okumura, S.; Suzuki, T.; Takikawa, K.; Tsuru, T.; Yoshida, H. (Tokyo Univ.). Phys. Rev. Lett., 21: 1288-91(Oct. 21, 1968).

The differential asymmetry ratio for the process $\gamma + n \rightarrow p + \pi^-$ was measured at 90° in the center-of-mass system and for incident photon energies from 352 to 550 MeV. The observed asymmetries are larger than the values predicted from the theory by Berends, Donnachie, and Weaver. A smaller M_1– amplitude gives better agreement between the experiment and the theory. (auth)

52919 MEASUREMENT OF $\gamma pN^*(1236)$-VERTEX FORM FACTORS. Baba, K. (Hiroshima Univ.); Huke, K. Genshikaku Kenkyu, 12: 339-54(Dec. 1967).

To determine the form factor $/f(q^2, e)/$ in the reaction $e^- + p \rightarrow e^- + N^*(1236)$, $N^* \rightarrow p + \pi^0$, where q^2 is the electron squared four-momentum transfer and E is the polarization parameter, the integrated forward cross section was measured at various values of the lab energy of the nucleon isobar under constant q^2 and E (E = 0.7 and 0.5). The measurements were done by using an external electron beam extracted from the Electron Synchrotron of the Institute for Nuclear Study, University of Tokyo. The electrons and protons were counted in coincidence and were identified by observing the pulse heights of the Cherenkov and the time-of-flight, respectively. The Dalitz-Yennie formula (Phys. Rev., 105: 1598 (1957)) was least-square-fitted to the experimental data. In order to estimate the integrated cross sections, the curves only in the region from the threshold to the resonance peak were used. The experimental values of the integrated cross section for the electroproduction of N*(1236) from which the decay proton is emitted into the forward direction were $(3.14 \pm 0.21) \times 10^{-33}$ cm^2 $sterad^{-2}$ for E = 0.7 and $(1.17 \pm 0.13) \times 10^{-33}$ cm^2 $sterad^{-2}$ for E = 0.5. From these values the form factors were found to be $|f_-(q^2 = 3F^{-2})|^2/|f_-(q^2 = 0)|^2 \cong 0.38$ and $|f_+(q^2 = 3F^{-2})|^2/|f_-(q^2 = 3F^{-2})|^2 \cong 1.64$. The experimental results were compared with the data obtained by Ash et al. (Phys. Letters, 24B: 165 (1967)) and were shown to be not inconsistent with their result. Furthermore, the counting rate of the scattered electrons without using the proton telescope for various values of the missing invariant mass near the pion threshold, keeping q^2 and E to be constant. The observed values were corrected mainly for the bremsstrahlung process and for the background from materials other than target. (NSA of Japan)

52920 TEST OF TIME-REVERSAL INVARIANCE IN ELASTIC ELECTRON SCATTERING FROM THE DEUTERON. Prepost, R. (Univ. of Wisconsin, Madison); Simonds, R. M.; Wiik, B. H. Phys. Rev. Lett., 21: 1271-4(Oct. 21, 1968).

A test of time-reversal invariance for an electromagnetic interaction at high momentum transfer has been performed by measuring the recoil-deuteron vector polarization for the elastic scattering of electrons from an unpolarized deuteron target for an incident electron energy of 1 GeV and a recoil-deuteron four-momentum of q = 721 MeV/c. The value obtained for the vector polarization is $|P| = 0.075 \pm 0.088$, showing no significant T nonconservation. (auth)

52921 PHASE OF $\pi\pi$ SCATTERING IN STATE WITH T = 0 AND T = 2. Leksin, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 165-75(July 1968). (In Russian).

The pion–pion scattering determines to a great extent the behavior of elementary particles in other reactions; this has been more closely examined in $K_2^0 \rightarrow 2\pi$ decays. In this respect, it is of special interest to determine the phase of the $\pi\pi$ scattering when the total energy equals the mass of the K meson. The goal of this study was to compare the phases of scattering in states with isospin of 2 and 0 (δ_2 and δ_0) with $\delta_2 - \delta_0 \approx 50°$ at energies of 500 MeV on the basis of experiments with K_2^0 mesons. Such studies are needed to resolve the contradictions in the nonconservation of the CP parity experiments. The data contained in earlier publications of other authors were analyzed. It was not found possible to determine the signs of the phases with certainty; different values were obtained near the threshold and the ρ meson region. If $\delta_0^0 > 0$, the original assumptions of M. Ferro-Luzzi et al., are incorrect; in the $\delta_0^0 < 0$ case, the data of W. O. Walker and E. Malamud et al., are accidental, or the ρ meson is not a Breit-Wigner resonance and the maximum of the pion cross section at 750 MeV corresponds to the passage of the δ_1^1 phase through −90°. (TTT)

52922 PHOTOPRODUCTION OF η^0 MESONS AT 4 GeV. Bellenger, D.; Deutsch, S.; Luckey, D.; Osborne, L. S.; Schwitters, R. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev. Lett., 21: 1205-8(Oct. 14, 1968).

A study of η^0 photoproduction at 4 GeV is described. The results are consistent with a theoretical prediction relating this cross section to ω^0 production by π mesons using a vector-dominance model. There is no evidence for a dip and change of slope at $-t = 0.6$ as seen in π^0 photoproduction. (auth)

Weak

52923 (AD-669491) POSITIVE-TAU ANALYSIS. Grauman, J.; Koller, E. L.; Taylor, S.; Pandoulas, D.; Hoffmaster, S. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Apr. 1968. Contract Nonr-3066(00). 15p. (SIT-P-216). CFSTI.

An analysis is presented of approximately 6500 $K^+ \rightarrow \pi^+ + \pi^+ + \pi^-$ decays at rest. These events were found in a systematic frame-by-frame scan of 70-mm bubble chamber film taken from the 30-

in. Columbia-BNL propane bubble chamber exposed to a separated positive-K meson beam. The energy spectra of the pions are compared to existing experimental data and to the spectra predicted by various theoretical models for τ-decay. (auth) (USGRDR)

52924 (LNF-68/43) THE STUDY OF K^0 MESON DECAYS BY COLLIDING BEAMS. Note No. 410. O'Neill, G. K. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). July 15, 1968. 3p. Dep.

The use of electron–positron storage rings for colliding beam experiments to study branching ratios and the lifetime of K_2^0 decay and also to study the CP violation parameters η_{+-} and η_{00} is discussed. (W.H.K.)

52925 NEUTRINO HELICITY. Schultz, Stephen (Univ. of Notre Dame, Ind.). Notre Dame Sci. Quart., 6: 6-8 (Dec. 1967).

The importance of the determination of the helicity of the neutrons by Goldhaber in the development of the theory of weak interactions following Lee and Yang's suggestion of parity nonconservation is reviewed. The problem of measuring the neutrino helicity reduces to that of determining the helicity of the γ ray for the case in which the two are emitted in opposite directions during electron capture and the following de-excitation. Requirements for resonance scattering are reviewed. The Goldhaber group used as a source $^{152m}Eu_{63}$, which appears to have the relevant properties. Polarization dependence of the Compton scattering cross section was used by passing the γ rays from the transition to the ground state in $^{152}Sm_{63}$ through Fe that could be magnetized either up (field opposite to direction of gamma ray propagation) or down. Details of the experiment are given. The experimental results are consistent with 100% negative helicity of the γ rays, and hence the helicity of the neutrinos emitted on electron capture is seen to be negative. No theory of β decay distinguishes between the neutrino emitted in orbital electron capture and that emitted in positron decay. It had already been shown that positrons are emitted from oriented nuclei in the direction in which the nuclear spin is pointing. Thus to account for the $\Delta J = 1$ in a Gamov–Teller transition, the two leptons must have parallel spins. So the neutrino, with spin and momentum antiparallel, must be emitted in the direction opposite to the positron, indicating an axial vector interaction. Consideration of similar results suggests that the Fermi decay is a vector interaction. (BBB)

52926 MEASUREMENT OF THE BRANCHING RATIO $(K_L \rightarrow \gamma\gamma)/(K_L \rightarrow 3\pi^0)$. Banner, M.; Cronin, J. W.; Liu, J. K.; Pilcher, J. E. (Princeton Univ., N. J.). Phys. Rev. Lett., 21: 1103-6 (Oct. 7, 1968).

The branching ratio $(K_L \rightarrow \gamma\gamma)/(K_L \rightarrow 3\pi^0)$ was measured to be $(2.24 \pm 0.28) \times 10^{-3}$. Combined with a recently reported branching ratio $(K_L \rightarrow 3\pi^0)/(K_L \rightarrow \text{all modes}) = 0.209 \pm 0.011$, $(K_L \rightarrow \gamma\gamma)/(K_L \rightarrow \text{all modes})$ was found to be $(4.68 \pm 0.64) \times 10^{-4}$. (auth)

52927 MEASUREMENT OF THE BRANCHING RATIO $(K_L \rightarrow 2\pi^0)/(K_L \rightarrow 3\pi^0)$. Banner, M.; Cronin, J. W.; Liu, J. K.; Pilcher, J. E. (Princeton Univ., N. J.). Phys. Rev. Lett., 21: 1107-11 (Oct. 7, 1968).

The branching ratio $(K_L \rightarrow 2\pi^0)/(K_L \rightarrow 3\pi^0)$ was measured to be $(4.6 \pm 1.1) \times 10^{-3}$. Combined with a recently reported branching ratio $(K_L \rightarrow 3\pi^0)/(K_L \rightarrow \text{all modes}) = 0.209 \pm 0.011$, $(K_L \rightarrow 2\pi^0)/(K_L \rightarrow \text{all modes}) = (0.96 \pm 0.23) \times 10^{-3}$ and $|\eta_{00}| = (2.3 \pm 0.3) \times 10^{-3}$ were obtained. (auth)

52928 COSMIC-RAY DISCOVERY. Lederman, Leon M. Comments Nucl. Particle Phys., 11: 131-5 (Sept.-Oct. 1968).

A brief review is given of recent cosmic-ray studies which lead to new implications for direct production of muons or production via a very short-lived parent. In particular, the experiment of the Utah group is considered, in which the spectrum of cosmic-ray muons was studied as a function of zenith angle. Further studies and speculations on the origin of the new process are reviewed. (L.B.S.)

52929 SEARCH FOR VIOLATION OF T-SYMMETRY IN β DECAY OF POLARIZED NEUTRONS. Erozolimskii, B. G.; Bondarenko, L. N.; Mostovoi, Yu. A.; Obinyakov, B. A.; Zakharova, V. P.; Titov, V. A. Yadern. Fiz., 8: 176-81 (July 1968). (In Russian).

Experiments concerning the verification of the T parity in weak interactions, involving in particular the determination of the triple correlation of the electron momentum (p_e), the neutrino momentum (P_γ), and the spin (σ) of the decaying nucleus in the β decay of nuclei, are of great interest for studying the effect causing nonconservation of the CP parity in the weak decay of K mesons. Determination of the angular correlation in the β decay of neutrons supplies arguments for the verification of the T parity. Effects of the nonconservation of the T invariance do not influence the electron–neutrino correlation and influence only slightly the neutron-spin and electron-spin correlations. It was attempted to improve the accuracy achieved in earlier measurements of this type, using a 3×10^7 n/sec neutron beam with a polarization of about 85°, reflected by nonmagnetic Co mirror. The magnetic field accompanying the beam causes a longitudinal orientation of the neutron spin within the chamber; direction of the spin was changed by 180° by means of a nonadiabatic inversion of the field. The effect looked for was determined by coincidence measurements on the basis of about 58,000 recorded events. The results revealed that there was a phase angle of $\theta = 179.0 \pm 1.6$ between axial and vector constants. Measurements of the triple correlation are still in progress. (TTT)

Strong (Baryon-Induced)

Refer also to abstracts 53086, 53087, and 53092.

52930 (KFKI-19/1968) PERIODICAL CHARGE-STATE FLIPPING PHENOMENA IN NEUTRON–PROTON SCATTERING. Hrehuss, G.; Czibok, T. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Aug. 7, 1968. 41p. Dep.

Periodical state-flipping phenomena analogous to those occurring in the case of electromagnetic excitations have been found in the case of neutron–proton scattering. The periodical charge-state flipping manifests itself as a corresponding fluctuation in the energy dependence of both the total cross section and the differential cross section at forward proton-angles. The flipping frequency measured is in good agreement with that estimated theoretically making use of a simple model for charge-exchange processes. (auth)

52931 (KFKI-20/1968) ON THE MULTIPLICITY DISTRIBUTION OF HIGH ENERGY PION–NUCLEON AND NUCLEON–NUCLEON INTERACTIONS BEYOND 1 GeV. Bozoki, G.; Gombosi, E.; Posch, M.; Vanicsek, L. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Aug. 2, 1968. 21p. Dep.

The experimentally observed multiplicity distributions of charged secondaries in pion–nucleon and nucleon–nucleon interactions at primary energies above 1 GeV are analysed. It is shown that these distributions can be well approximated by a function of the form $f(n) = c^{-1} \cdot n^{\beta-1} e^{-n^2/2\alpha^2}$. The energy dependence of the parameters β and α and that of the average multiplicity, the ratio of the average multiplicity to the dispersion, and the inelastic cross section for the production of n charged secondaries are investigated. Rules for the ratio of the inelastic cross section for the production of n charged secondaries in πN interactions to that of NN interactions, as well as for the ratio of the average multiplicity of πN interactions to that of NN interactions are established. (auth)

52932 STUDY OF INELASTIC PROTON–PROTON SCATTERING AT 12.5 GeV/c. Asbury, J. G. (Argonne National Lab., Ill.); Ratner, L. G.; Read, A. L.; Crabb, D. G.; Day, J. L.; Krisch, A. D.; Lin, M. T.; Marshak, M. L. Phys. Rev. Lett., 21: 1097-9 (Oct. 7, 1968).

The model that the three regions observed in p-p elastic scattering are the diffraction scattering due to π, K, and $\bar{p}$ production was tested experimentally. The inelastic p-p cross section was measured on circles of constant P_{cm}. One contained a pure sample of inelastic π events; the other, both π and K events. The cross section has a break on both circles showing that the break is not due to K mesons and that the model is wrong. (auth)

52933 SEARCH FOR RESONANCE FORMATION IN ANTIPROTON–PROTON ELASTIC SCATTERING FROM 1.6 TO 2.2 GeV/c. Lys, J.; Chapman, J. W.; Falconer, D. G.; Murphy, C. T.; Vander Velde, J. C. (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 21: 1116-19 (Oct. 7, 1968).

The antiproton-proton elastic differential cross section was measured in the center-of-mass angular range $\cos\theta = -0.985$ to +0.40 at six momenta between 1.6 and 2.2 GeV/c in a bubble-chamber experiment. The data are used to look for evidence of direct-channel boson resonances. (auth)

52934 ENERGY-DEPENDENT STRUCTURE IN BACKWARD-HEMISPHERE $\bar{p}p$ ELASTIC SCATTERING AND HIGH-MASS BOSONS. Cline, D.; English, J.; Reeder, D. D.; Terrell, R.; Twitty, J. (Univ. of Wisconsin, Madison). Phys. Rev. Lett., 21: 1268-71 (Oct. 21, 1968).

We have observed a strong backward peak in the differential cross sections of backward-hemisphere $\bar{p}p$ elastic scattering in the momentum range 300 to 700 MeV/c. The differential cross section near 180° and near 90° shows energy-dependent fluctuations. A consistent interpretation of these fluctuations can be made in terms of direct-channel boson resonances with masses and widths (m_r,Γ_r), in MeV, of (~1925, ~10) and (1945,~ 20), and

a state with mass greater than ~1975 MeV and width greater than 20 MeV. (auth)

52935 TIME-REVERSAL INVARIANCE AND PROTON TRIPLE SCATTERING. Limon, Peter Jacob. Madison, Wis., Univ. of Wisconsin, 1968. 69p.

Thesis.

A proton-proton triple scattering experiment was performed to check time reversal invariance in the strong interactions. An incident polarized proton beam at 430 MeV was scattered in liquid hydrogen, and the final state polarization measured with a wire spark chamber, carbon plate polarimeter. The data analysis was performed on line by a digital computer. It was found that two polarization components which would be equal if time reversal invariance was valid had a difference $P_A - P_B = 0.0019 \pm 0.0090$. An upper limit was set on the time reversal violating matrix element T; $|T|\cos\alpha \leq 0.01\sqrt{mb}$ where α is the phase angle between T and time reversal and parity conserving matrix element. The time reversal violating phase shift λ_2 was found to be less than 15% of its maximum value. In addition, the Wolfenstein triple scattering parameters D, R, A, R′, and A′, and the polarization P, were determined at 65° and 115° center of mass scattering angles. Using these data, a solution was found to the proton-proton M-matrix which seems to be unique. This solution is compared with a phase shift solution, and good agreement is found. (Disser. Abstr.)

Strong (Meson-Induced)

Refer also to abstract 52931.

52936 (BNL-12364) SEARCH FOR I = 3/2 Ξ RESONANCES IN K^-n INTERACTIONS AT 3.6 AND 3.9 GeV/c. Crennell, David J.; Delaney, William C.; Flaminio, Enzo; Karshon, Uri; Kwan, Wu; Metzger, Wesley, J.; O'Neall, John S.; Scarr, J. Michael; Schumann, Thomas G.; Thorndike, Alan M. (Brookhaven National Lab., Upton, N. Y.). [1966]. 8p. (CONF-680809-31). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

Bubble chamber interactions $K^- + n \rightarrow \Xi^- + \pi^- + K^+$, $K^- + n \rightarrow \Xi^- + \pi^- + \pi^+ + K^0$, and $K^- + n \rightarrow \Xi^- + \pi^- + \pi^0 + K^+$ were studied at 3.6 and 3.9 GeV/c, but no positive evidence was found for the existence of I = 3/2 Ξ resonances. This gives an upper limit of ~7 μb for production of any $\Xi^-\pi^-$ or $\Xi^-\pi^-\pi^0$ resonances, assuming a width of approximately 80 MeV and a mass less than 2.0 GeV, with a 99% confidence level. (W.H.K.)

52937 (LA-4002) BIBLIOGRAPHY OF INTERACTIONS OF NUCLEONS WITH NUCLEONS IN THE ENERGY RANGE 100 keV TO 1 GeV. Furnish, Jean (comp.) (Los Alamos Scientific Lab., N. Mex.). July 12, 1968. Contract W-7405-eng-36. 81p. Dep. CFSTI.

A search of Nuclear Science Abstracts from Volume 20 (1966) through Volume 22, Number 12 (June 30, 1968) was made for information on the following types of interactions: neutrons with neutrons, neutrons with protons, and protons with protons. In general the energy range was limited to 100 keV to 1 GeV, and theoretical as well as experimental papers have been included. The abstracts are arranged in numerical order within each volume of NSA with the abstracts from the most recent volume placed first. (auth)

52938 SEARCH FOR MULTIPION RESONANCES WITH I = 2. Katz, W.; Ferbel, T.; Slattery, P.; Yamanouchi, T.; Yuta, H. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 21: 1114-16 (Oct. 7, 1968).

A search for I = 2 multipion resonances (χ^{--}) was performed in reactions of the type $\pi^-n \rightarrow px^{--}$, where χ^{--} decays into $\pi^-\pi^+\pi^-\pi^-$ with or without extra π^0 mesons. The results at a π^- beam momentum of 7 GeV/c indicate that if these resonant states exist and if they have widths of ≤160 MeV, then they are produced only with cross sections which are one to two orders of magnitude lower than the production cross sections measured for the well-established resonances. (auth)

52939 ΛππSTRUCTURE FROM 1600 TO 1740 MeV. Bartley, J. H. (Tufts Univ., Medford, Mass.); Chu, R. Y. L.; Dowd, R. M.; (and others). Phys. Rev. Lett., 21: 1111-14(Oct. 7, 1968).

Total cross sections for the processes $K^-p \rightarrow \Lambda\pi^+\pi^-$ and $K^-n \rightarrow \Lambda\pi^-\pi^0$ (pure T = 1) were measured as a function of center-of-mass energy. From these the ΛππT = 0 cross section was determined. The data indicate the existence of a Λππ decay of the $Y_0^*(1690)$. (auth)

52940 EVIDENCE FOR Ξ* RESONANCE WITH MASS 1930 MeV. Alitti, J. (Brookhaven National Lab., Upton, N. Y.); Flaminio, E.; Metzger, W.; (and others). Phys. Rev. Lett., 21: 1119-23(Oct. 7, 1968).

Evidence is presented for the existence of a baryon with a strangeness S = −2, mass M = 1930 ± 20 MeV, and width Γ = 80 ± 40 MeV. It is speculated that this resonance completes a $J^P = 3/2^-$ octet. An SU(3) analysis of the conjectured $3/2^-$ octet gives a reasonable overall description of the partial widths of the member states. (auth)

52941 STUDY OF $Y_1^*(1660)^1 \rightarrow \Sigma^0\pi^+$ (AND $\Lambda\pi^+$). Button-Shafer, J. (Univ. of California, Berkeley. Univ. of Massachusetts, Amherst). Phys. Rev. Lett., 21: 1123-8(Oct. 7, 1968).

Large samples of $Y_1^*(1660)^1 \rightarrow \Sigma^0\pi^+$ were analyzed. Little Λπ decay was observed, but Σπ and $Y_2^*(1450)\pi$ modes were comparable. The spin and parity conclusion from $\Sigma^0\pi$ study is $3/2^-$. (auth)

52942 SOME CHARACTERISTIC FEATURES OF SIX PRONG π^-p INTERACTIONS AT 7.0 GeV/c. Ijaz, M. A.; Campbell, J. (Virginia Polytechnic Inst., Blacksburg). Nucl. Phys., B7: 175-82(1968).

About 1500 six prong events were measured from an exposure of 7.0-GeV/c negative pions in the BNL 80 inch liquid hydrogen bubble chamber. The results are presented on the nature of transverse-momentum distributions (p_t), center-of-mass angular distributions and angular correlations among the pions of different charges. The p_t distributions agree well with the Hagedorn thermodynamical model yielding for the "temperature" a value of about 120 MeV for the pions and 148 MeV for the nucleons. The nucleon shows a backward peaking in the c.m. system and the charged pions hve a slight peaking in the forward direction. Neutral pions are very nearly isotropic. The value of the angular correlation parameters agrees with the statistical model. (auth)

52943 MEASUREMENT OF THE POLARIZATION PARAMETER IN π^+P SCATTERING FROM 750 TO 3750 MeV/c. Johnson, Claiborne Holt Jr. Berkeley, Calif., Univ. of California, 1967. 163p.

Thesis.

We have measured the polarization parameter in π^+p elastic scattering at fifteen lab momenta from 745 to 3745 MeV/c. The positive pion beam was focused on a one-cubic-inch polarized proton target and both final-state particles were detected by scintillation counter hodoscopes. On the basis of their coplanarity and opening angle, elastic events involving polarized protons were distinguished kinematically from background events. The polarization parameter was obtained by observing the asymmetry in counting rates detected when the target was polarized successively parallel and antiparallel to the normal of the scattering plane. These results, combined with those of other experiments are being used to conduct a phase-shift analysis of the pion-nucleon system at 19 energies from 490 to 1566 MeV (1443 to 2025 MeV total center-of-mass energy). Several comments about this analysis and a tentative solution are presented. This solution is not in disagreement with earlier analyses, but its uniqueness has not yet been firmly demonstrated. (Disser. Abstr.)

52944 A STUDY OF THE REACTIONS $K^-p \rightarrow K^-p\,\pi^+\pi^-\pi^0$ AND $K^-p \rightarrow K^-n\,\pi^+\pi^+\pi^-$ AT 4.6 AND 5.0 BeV/c. Juhala, Roland Edwin. Iowa City, Iowa, Iowa State Univ., 1968. 143p.

Thesis.

The final states $K^+p\,\pi^+\pi^-\pi^0$ and $K^-n\,\pi^+\pi^+\pi^-$ were studied in K^-p interactions at 4.6 and 5.0 BeV/c. The data were prepared from 28,000 pictures at each momentum taken in the 80″ bubble chamber at BNL. The cross sections for production of the final state $K^-p\,\pi^+\pi^-\pi^0$ are 0.76 ± 0.09 mb and 0.93 ± 0.12 mb, and for the final state $K^-n\,\pi^+\pi^+\pi^-$ 0.42 ± 0.06 mb and 0.39 ± 0.07 mb at 4.6 and 5.0 GeV/c, respectively. The effective mass distributions were studied by combining the data from both momenta. The effective cross sections for the combined data are .83 ± .12 mb for the $K^-p\pi^+\pi^-\pi^0$ final state and .41 ± .07 mb for the $K^-n\pi^+\pi^+\pi^-$ final state. The combined $K^-n\pi^+\pi^+\pi^-$ data consist of 701 events. The resonance production includes $\overline{K}^{*0}(890)$: 29 ± 4%, $\Delta^-(1236)$: 17 ± 3% and $\Delta^+(1236)$: 7.0 ± 2.0%. There is, in addition, evidence for an enhancement at 960 MeV/c^2 in the $\pi^+\pi^+\pi^-$ mass spectrum of magnitude 6 ± 2%. A lower limit on double resonance production is estimated to be 5% with some evidence for $\Delta^-K^{*0}\,\pi^+$: 3.7 ± 1.7%. No resonance observed in this final state could be understood exclusively on the basis of a single particle exchange process. The combined $K^-p\pi^+\pi^-\pi^0$ data consist of 1305 events. The resonance production includes $K^{*0}(890)$: 19 ± 3%, $K^{*-}(890)$:, 7.2 ± 1.7%, $\Delta^{++}(1236)$: 15 ± 3%, $\Delta^+(1236$: 8 ± 3%, $\Delta^0(1236)$: <2%, $\omega^0(784)$: 14.5 ± 3.0%, $\eta(548)$: 3.3 ± 1.3%, $A1^0(1080)$: 10.5 ± 3.0%, $A2^0(1300)$: 3.0 ± 1.5%, $\rho^+(760)$: 9.0 ± 2.5% and $\rho^-(760)$: 5.5 ± 2.0%. A spin analysis of the $A1^0(1080)$ indicates an unnatural spin and parity assignment with 1^+ preferred. A lower limit on double resonance production is 6% with some evidence for $\Delta^+\overline{K}^{*0}\,\pi^-$: 4.0 ± 1.5% and $\Delta^{++}K^{*-}\pi^-$: 2.3 ± 1.0%. There is an indication for $\Delta^{++}(1236)$ production via a one-pion-exchange diagram. In general these two

final states exhibit much larger four-momentum transfers to the baryon than the corresponding three- or four-body final states. Center-of-mass angular distributions for the baryon resonances were significantly backward peaked, while the K^* distributions were forward peaked, but no more so than for the background obtained by slicing above and below the resonance region. Quasi-two-body production due to small contributions from several channels, while marginal, could not be excluded. (Disser. Abstr.)

52945 K^+p SCATTERING AND A POSSIBLE Z* RESONANCE. Martin, B. R. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 21: 1286-7(Oct. 21, 1968).

An energy-dependent phase-shift analysis in the kaon laboratory-momentum range below 2.0 BeV/c has been made of K^+p scattering data, supplemented by information from K^+p forward dispersion relations. Evidence for a possible resonance in the P_{13} state is presented. (auth)

52946 STUDY OF THE REACTION $\pi^+n \rightarrow \pi^0\pi^0p$ AT 2.15 GeV/c. Braun, K. J.; Cline, D.; Scherer, V. (Univ. of Wisconsin, Madison). Phys. Rev. Lett., 21: 1275-8(Oct. 21, 1968).

We report on an experimental study of the reaction $\pi^+d \rightarrow \pi^0\pi^0pp$ at 2.15 GeV/c for $|t| < 10\mu^2$, with emphasis on the measurement of the absolute $2\pi^0$ cross section. A direct comparison with $\pi^+\pi^-$ production at the same energy is made. In addition, comparison with the analysis of Malamud and Schlein provides support for the one-pion-exchange model as well as support for a large T = 0, I = 0 $\pi\pi$ phase shift in the ρ mass region. (auth)

52947 K^+p BACKWARD SCATTERING IN THE REGION FROM 1.0 TO 2.5 GeV/c. Carroll, A. S. (Brookhaven National Lab., Upton, N. Y.); Fischer, J.; Lundby, A.; Phillips, R. H.; Wang, C. L.; Lobkowicz, F.; Melissinos, A. C.; Nagashima, Y.; Smith, C. A.; Tewksbury, S. Phys. Rev. Lett., 21: 1282-5(Oct. 21, 1968).

Elastic scattering of K^+ mesons from protons in the backward direction has been measured to high accuracy. The data indicate that baryon exchange is extremely important for $P_{lab}(K) > 1.8$ GeV/c. A phase-shift analysis of the data suggests the existence of a P_{13} resonance in the K^+p system at a mass of approximately 2 GeV/c^2. (auth)

42948 THE 3π MASS SPECTRUM IN THE REACTION $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ AT 13 AND 20 GeV/c. Ioffredo, M. L.; Brandenburg, G. W.; Brenner, A. E.; (and others) (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 21: 1212-16(Oct. 14, 1968).

In the 3π mass spectrum from the reaction $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ at 13 and 20 GeV/c, we observe an unstructured A enhancement and the production of the $\pi(1640)$ meson. Our data for the $\pi^-\rho^0$ mass are compared with the predictions of the one-pion exchange, the diffraction-dissociation, and the double-Regge-pole models. Only the double-Regge-pole model is able to reproduce the shape of the A enhancement. (auth)

Particle Interactions and Properties (Theoretical)

General

52949 (AED-C-23-29) HIGH ENERGY PHYSICS INDEX. Volume 6, No. 8 (4135-5187). (Zentralstelle fuer Atomkern-energie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 272p. Dep.

An index of high-energy physics reports received at DESY is presented. An author index, preprint and report number index, and a subject index are included. (W.H.K.)

52950 ON CURRENT-DENSITY ALGEBRAS, GRADIENT TERMS AND SATURATION: CONSERVED CURRENTS. Voelkel, Uta; Schroer, B.; Voelkel, A. H. (Univ. of Pittsburgh). Contract AT(30-1)-3829. Commun. Math. Phys., 10: 69-92(1968).

The equal-time limit of commutator matrix elements of conserved currents is rigorously calculated by means of structures which follow from general principles of relativistic quantum field theory and current conservation. It is proved that: (a) In general derivatives of δ-functions occur (gradient terms). – (b) The proper (non-gradient) part of the equal time limit is exactly given by the divergence-free causal one-particle structures constructed from those intermediate one particle states which have the same main quantum numbers (mass, total spin and total isospin) as one of the external states (saturation by two one particles states!). – (c) All the other intermediate discrete one particle states drop out completely and the continuous many particle states contribute at most to gradient terms. – (d) The gradient terms emerging from the remaining two discrete intermediate one particle states can be removed without any restrictions on the form factors. – (e) From current algebras of conserved currents in the form proposed and used in the literature one cannot deduce any predictions for form factors beyond the algebraic conditions for coupling constants which already follow from the algebra of the charges. (auth)

52951 REVIEW OF THE PERSPECTIVES IN RESEARCH WORK IN HIGH-ENERGY NUCLEAR PHYSICS IN CZECHOSLOVAKIAN SSR. Petrzilka, Vaclav; Vancura, Antonin. Vestn. Cesk. Akad. Ved., 77: 439-58(1968). (In Czech).

A brief review is given of the range and perspectives of research work in high energy nuclear physics carried out by Czech SSR. 311 references are included. (R.V.J.)

52952 PATH INTEGRAL FOR SPIN. Schulman, Lawrence Simon. Princeton, N. J., Princeton Univ., 1967. 136p. Thesis.

A path integral for spinning particles is developed. It is a one particle theory, equivalent to the usual quantum mechanics. In studying the relativistic version of this theory some observations are made on spin and internal variables. It is shown that under very general assumptions any internal coordinates can be broken up into those that give rise to the spin (alone) and those that are completely internal, i.e., unaffected by Lorentz transformation. The spin space must be some coset space of the little group of the Poincare group (for the momentum in question). This is the analogue of the trivial nonrelativistic elimination of rotational coordinates in the study of, e.g., polyatomic molecules. The path integral theory takes as a classical model for spin the spherical top and quantizes this by a sum over histories. The curvature and multiple connectedness of the top coordinate space (SO(3)) provide some interesting features in the sum. By the aforementioned general remarks, the top is also used in relativistic path integral, although in that case the classical mechanics is complicated by the Thomas precession. Equivalence of this theory with the Dirac equation has not been proved in the case of interactions with an external electromagnetic field. The multiplicity of the top states, and a similar phenomenon for massless particles (whose states are also determined by the foregoing general observation), yield a collection of states suitable for a representation of the leptons. (Disser. Abstr.)

52953 COMPOSITE PARTICLES WITH ROTATIONAL MASS LEVELS. Miyazaki, Tadashi (Tokyo Univ.). Prog. Theor. Phys. (Kyoto), 40: 427-8(1968).

The wave equation of particles with rotational mass levels is formulated. A solution is presented using sixteen-component spinor formulation for a composite system of particles with three internal Lorentz groups. Properties of the particles are discussed. (L.B.S.)

52954 NATURAL CONSTANTS AND THE BACH THEORY. Lewis, D. T. (Lab. of Government Chemist, London). Chem. Ind. (London), No. 39, 1301-3(Sept. 28, 1968).

The bach theory of sub-nuclear particles is discussed with reference to electrostatic systems and gravitational systems. The bach–Zeus relationships are also discussed. For previous references on the bach theory see Nature 216: 573, 784 and 1199 (1967), and Chem. and Ind. 23: 729 and 35: 1173 (1968). (UK)

52955 WAVE FUNCTIONS FOR PARTICLES WITH HIGHER SPIN. Gabos, Z. (Babes-Bolyai Univ., Cluj). Acta Phys. Pol., 34: 223-30(Aug. 1968). (In French).

Plane wave solutions for particles and antiparticles with spin $s \leq 2$ of finite rest mass m_0, momentum $\vec{p}$, helicity λ for wave functions with $2(2s + 1)$ components are given. (tr-auth)

Electromagnetic

Refer also to abstracts 52921, 52965, 52977, and 52987.

52956 (UCD-CNL-81) EXACT EVALUATION OF THE LOWEST ORDER VACUUM POLARIZATION CONTRIBUTIONS TO THE MAGNETIC MOMENT OF THE MUON. Erickson, Glen W.; Liu, Henry H. T. (California Univ., Davis. Crocker Nuclear Lab.). July 1968. Contract AT-11-1-GEN-10. 13p. Dep. CFSTI.

The contribution of the lowest order vacuum polarization diagram to the anomalous magnetic moment of a lepton is given in closed form for all values of the mass of the virtual pair. The calculation independently verifies Elend's calculation, as corrected by Kroll, and the result, in terms of Spence functions, is simpler than that given by Elend. Attention is directed to some useful but not well-known Spence function identities. (auth)

52957 SELF-CONSISTENT CALCULATION OF THE MEDIUM STRONG AND ELECTROMAGNETIC MASS SPLITTINGS OF THE

BARYON OCTET. Cohen, Stephen L. New York, Univ. of Rochester, 1968. 100p.
Thesis.

A mechanism is suggested whereby the medium strong and electromagnetic mass splittings within the baryon octet might arise as a dynamical consequence of the SU_3 violating medium strong and electromagnetic interactions. In particular, the electromagnetic mass splittings which are of the opposite sign from the classical result are examined. For the dynamical mechanism, the Lehmann spectral representation is used for the baryon inverse two point function, assuming that the occurrence of mass splittings within the baryon octet may be understood as being generated, as a low energy effect, by the mass splittings within the pseudo-scalar meson octet. Thus the meson mass splittings constitute the driving force for the baryon mass splittings. The result is that expressions for the baryon mass splittings are arrived at which involve three parameters: the very strong SU_3 symmetric coupling constant g^2, the parameter f which measures the relative weighting of F type and D type coupling, and a cutoff Λ which is a consequence of the usual divergences of perturbation theory. The physical baryon masses are used as the input and solutions for the set of parameters g^2, f, and Λ are obtained, comparing the results with experiment. The result is $g^2/4 = 8.87$, $f = 0.195$, $\Lambda = 2.6$ in the medium strong case and $g^2/4 = 16.7$, $f = 0.167$, $\Lambda = 2.4$ in the electromagnetic case. Finally it is demonstrated that no singularity appears in the mass difference expressions when g^2 or Λ are allowed to vanish. (auth) (Disser. Abstr.)

52958 ELECTROMAGNETIC SELF-ENERGIES. Fishbane, Paul Martin. Princeton, N. J., Princeton Univ., 1968. 135p.
Thesis.

The effect of interactions on the masses of particles in that channel and in particular the electromagnetic interaction is studied. An attempt is made to express self-energies in terms of various scattering quantities which may result from the interaction. A review is first given of previous work, with strong emphasis on various calculations of the neutron-proton mass difference, assumed to be due solely to electromagnetism. Among the work discussed is that of Benoit, and a new field theoretic result is given for the electron self energy in terms of scattering amplitude matrix elements by his methods, as well as the S-matrix perturbation theory of Dashen and Frautschi, the feedback approach to the spin of the neutron-proton mass difference of Pagels, and sum rules developed by Cottingham. The Lee Model is discussed in order to give the V particle mass shift as an integral over $N - \theta$ scattering phase shifts. Dispersion theory is applied to express this self-energy as another sum over phase shifts, and Benoit's method to a different approach to this problem. An expanded exactly soluble Lee model with inelasticity is examined to express the V self-energy as an integral over a sum of scattering eigenphaseshifts. The electron self-energy in quantum electrodynamics is expressed via sidewise dispersion relations as a sum over certain multipoles of Compton scattering. It is shown that this approach very readily gives the correct result in the perturbation theory limit. Finally sidewise dispersion relations are used to examine the neutron-proton mass difference to order e^2. In this case a nucleon-pion intermediate state is included as well as a nucleon-photon state, which can lead to the correct sign for the mass difference. The result is expressed in terms of photoproduction amplitudes. (TSS) (Disser. Abstr.)

52959 ELECTROMAGNETIC PRODUCTION OF PIONS FROM NUCLEI. Saunders, L. M. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys., B7: 293-310(1968).

The processes of photoproduction and electroproduction of pions from complex nuclei are studied theoretically. The impulse approximation is used to relate the nuclear transition amplitude to that for pion production from a nucleon. Final-state interactions of the outgoing pion with the residual nucleus are included by using an optical model. Several experiments are analyzed and proposed such as the production of a charged meson to the analog of the ground state. It is observed that because of the vanishing of the spin-independent part of the pion production amplitude at forward directions certain reactions depend upon a single matrix element, a parity-forbidden matrix element in the terminology of beta decay, which can therefore be measured directly for a wide range of momentum transfers to the nucleus. A numerical example is given for the reaction $^{16}O\ (e,e'\pi^+)^{16}N$ to the 1^- state in ^{16}N. Numerical comparison of the theory with π^0 photoproduction experiments show that the results are very sensitive to the depth and form of the pion optical potential. The experimental results exceed the calculated values; a possible reason is given. Theoretical predictions for the analog reactions $^{88}Sr(e,e'\pi^-)^{88}Y$, $^{88}Sr(\gamma,\pi^-)^{88}Y$ and $^{42}Ca(e,e'\pi^-)^{42}Sc$ are made. (auth)

52960 NUCLEON FORM FACTORS FROM A SIDEWISE DISPERSION RELATION. Grunbaum, L. (Max Planck Institut fuer Physik and Astrophysik, Munich); Yu, D. Nucl. Phys., B7: 255-67 (1968).

The electromagnetic structure of the nucleons is investigated by using sidewise dispersion relations. It is assumed that the pion contributes the main part to the electromagnetic form factors of the nucleons. Good agreement with the experimental values is found for the charge and the magnetic radii whereas the theoretical magnetic moment of the proton is too small. (auth)

52961 ELECTROMAGNETIC PROPERTIES OF THE KAON. Renard, F. M. (Departement de Physique Mathematique, Montpellier, France). Nucl. Phys., B7: 183-200(1968).

The electromagnetic properties of the kaon are discussed in connection with those of the pion. The form factors are examined with the help of the unitarity symmetry, quark model, vector dominance and pology. Their influence on the mass difference is then analyzed in the framework of the low-energy phenomenology for the virtual Compton scattering. For the kaon in addition to the elastic and inelastic terms the influence of the exchange in the t-channel of the $I = 1\ \pi\gamma(1016)0^+$ meson is considered. The right sign and order of magnitude for δm_K is predicted using the quark model for the 0^+-γ-γ coupling. (auth)

52962 ELECTRON-POSITRON DECAY OF THE NEUTRAL PION. Sachs, David Stephen. New York, New York Univ., 1967. 48p.
Thesis.

The decay of the neutral pi meson into an electron–positron pair is analyzed, and the rate compared with the two-photon mode. It is assumed that the vector dominance model of Gell-Mann, Sharpe, and Wagner (1962) holds, the the decay takes place in three stages; first the pion becomes two virtual vector mesons, then each of the vector mesons becomes a photon, and finally the two photons produce the electron–positron pair. The two-photon decay is treated by the same methods. The matrix elements arising from the lowest order Feynman diagrams for the electron–positron decay process are computed approximately. Terms involving the ratios of electron mass to pion mass, and the pion mass to the vector meson masses are ignored when feasible. The predicted rate for the electron–positron decay mode is 6.0×10^{-8} of the rate of the 2-photon mode, or one such decay in every 16 million pion events, and agrees with an earlier prediction by Berman and Geffen (1960). Their result is, however, based on inserting an arbitrary cutoff factor, not derived from any physical model, and depends on the value of the cutoff. Analysis of the background caused by the electron–positron–photon decay mode indicates that if a sufficiently large number of pion decays are observed, and if the particle momenta are measured with sufficient accuracy, the electron–positron decay mode rate can be measured by a suitable experiment. Estimates for the related decay modes of the eta meson, obtained from the formula for the electron–positron decay mode of the pion, by substituting the proper masses, are one electron positron event in 8.8×10^7, and one muon antimuon event in 70,000 electromagnetic eta decays. (Disser. Abstr.)

52963 INTEGRALLY CHARGED QUARKS AND 2γ DECAY OF π^0 AND η. Otokozawa, Jun (Univ. of Minnesota, Minneapolis); Suura, H. Phys. Rev. Lett., 21: 1295-9(Oct. 21, 1968).

It is shown that the Nambu-Han model of integrally charged quarks can account for both $\pi^0 \rightarrow 2\gamma$ and $\eta \rightarrow 2\gamma$ decay rates with a suitable specification of 0^- and 1^- meson states in charm space. (auth)

Weak

Refer also to abstract 53081.

52964 (DESY-68/44) PION PRODUCTION WITH POLARIZED PHOTONS AND TEST OF VECTOR DOMINANCE MODEL. Geweniger, Chr.; Heide, P.; Koetz, U.; Lewis, R. A.; Schmueser, P.; Skronn, H. J.; Wahl, H.; Wegener, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany). Hamburg Univ. (West Germany). II. Institut fuer Experimentalphysik). Aug. 1968. 5p. Dep.

Cross section asymmetries for the sum of single π^+ and π^- production with polarized photons were measured. The results disagree with calculations based on the vector dominance model using experimental data of vector meson production in π beams. (auth)

52965 (LPTHE-TH-68/17) ELECTROMAGNETIC CORRECTIONS TO $K \rightarrow 3\pi$ RATES. Neveu, A.; Scherk, J. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). [1968]. 7p. Dep.

A simple model is used to calculate part of the electromagnetic corrections to $K \to 3\pi$ decay rates, and their consequences on the predictions of various selection rules in non-leptonic decays of kaons. Comparison is made with experimental data. (auth)

52966 COHERENT COSMIC-RAY MODEL BASED ON "DIRECT" MUON PRODUCTION. Bergeson, H. E.; Keuffel, J. W.; Larson, M. O.; Mason, G. W.; Osborne, J. L. (Univ. of Utah, Salt Lake City). Phys. Rev. Lett., 21: 1089-93(Oct. 7, 1968).

A cosmic-ray muon model is considered in which a "directly produced" muon component with the same slope as the primary spectrum is added to the conventional pion-derived muons. It is found to be consistent with recent burst measurements, horizontal-air-shower data, atmospheric gamma-ray fluxes, and muon spectrograph measurements. It may also explain the anomalous mu-less air showers. The model requires that the photonuclear cross section increase at very high energies. (auth)

52967 K_{l3} DECAY FORM FACTORS AND CURRENT ALGEBRA. Srivastava, P. P. (CERN, Geneva). Nucl. Phys., B7: 220-6(1968).

The form factors in K_{l3} decay are discussed in a current algebra approach by writing unsubtracted dispersion relations for the matrix elements of suitable retarded commutators between single particle states and vacuum, at (arbitrary) fixed linear combination of the two momentum transfers. This allows the contributions of all the relevant poles to be included. A consistent solution of the current algebra equations is then possible. (auth)

52968 EXCHANGE CURRENT AND LEPTONIC DECAYS OF BARYONS IN THE QUARK MODEL. Kobayashi, Tsunehiro; Konno, Kimiaki (Waseda Univ., Tokyo. Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 40: 339-52(Aug. 1968).

Contributions of the meson exchange currents to the leptonic decays of baryons are investigated within the framework of the quark model based on the same line of thought of previous papers, in which the exchange magnetic moment and the decays of decuplet baryons are studied. It is shown that the meson exchange current among the constituent quarks gives little effects on the leptonic decays of baryons. The main contribution to the axial vector part comes from a pseudoscalar meson exchange current, while a pseudoscalar-vector meson exchange current contributes to the vector part. Their contributions are, indeed, so small that the "additivity" property of the quarks is shown to be a good approximation. In particular, in the neutron β-decay the exchange currents give only a little contribution and the relation $G_A/G_V = -\frac{5}{3}$ obtained from the "additivity" assumption cannot be improved. (auth)

Strong (General)

52969 HADRONS AND QUARKS. Gudehus, Timm (Deutsches Elektronen-Synchrotron, Hamburg). Umsch. Wiss. Tech., 15: 472(July 18, 1968). (In German).

The qualitative features of the quark model of hadrons are summarized. The difficulties in the mathematical formulation within the framework of modern quantum mechanics are indicated. Attempts to understand the model within the framework of relativistic quantum mechanics are summarized. (J.S.R.)

52970 EFFECTIVE MASS ANALYSIS IN COSMIC RAY JETS. Sedlak, J.; Simak, V.; Votruba, M. F. (Inst. of Physics, Prague). Czech. J. Phys., 18: 995-1002(1968).

The method of invariant mass spectra of groups of particles, known from the search for multiparticle resonant states in high energy physics, is applied to secondary particles in cosmic ray jets. The results are discussed in connection with the fire-ball model and the H-quanta model for the multiple production of particles in a very high energy region. (auth)

52971 REARRANGEMENT OF SAKATONS AND HIGH ENERGY TWO-BODY SCATTERING. Imachi, Masahiro; Matsuoka, Takeo; Ninomiya, Kansuke; Sawada, Shoji (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 40: 353-78(Aug. 1968).

The high energy two-body and quasi-two-body hadron-hadron scatterings are investigated from the viewpoint of the composite theory. It is shown that the scatterings are well described by a sum of the rearrangement interactions of the sakaton, where the number of the rearrangements n_R plays an important role. The energy dependence of the scattering amplitude T is assumed to be expressed by use of the n_R as $T \propto [(p_L)^{-\gamma}]^{n_R}$, where p_L is the incident laboratory momentum and γ is a parameter. The experimental energy dependence of the cross sections for various two-body scatterings is well reproduced if we take $\gamma = 0.25$. From the analysis of the elastic forward scattering it is found that the additivity assumption for interactions gives correct relations between total cross sections and the slopes of diffraction peaks. This suggests that the additivity assumption for interactions is favorable to that for scattering amplitudes. For a description of the backward scattering by the rearrangement of the sakatons, the quark model or three-triplet model is consistent with experiment but other composite models such as the quartet model is not. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 52985.

52972 (BNL-12783) STATUS OF η' AND δ BOSONS. Samios, N. P. (Brookhaven National Lab., Upton, N. Y.). [1968]. 15p. (CONF-680428-12). DTIE.

From Conference on Experimental Meson Spectroscopy, Philadelphia, Pa.

The status of the η' (or X°) and δ bosons is discussed. These reported particles have approximately the same mass and width. The question is considered as to whether a) the δ exists and b) if it exists, is it the same or different from the η'. The situation concerning the η' is clarified. All experiments agree with spin parity $J^P = 0^-$, isotopic spin I = 0, and G parity G = +1. The source of information is summarized. (auth)

52973 CONSTRAINTS ON STRONG-INTERACTION AMPLITUDES IMPOSED BY P.C.A.C. AND CURRENT ALGEBRA. Chang, Lay Nam. Berkeley, Calif., Univ. of California, 1967. 103p.

Thesis.

Using the hypothesis of the partially conserved axial-vector currents, and specific assumptions on the equal-time commutation relations, a calculation of the pion production amplitude near threshold of the πN system was attempted. The resulting matrix elements are contrasted with those obtained previously by other means, and a comparison with existing data on total cross section and angular distribution is made. Agreement is favorable for the energy range considered. Unlike previous studies of the production amplitudes where direct π-π interactions are thought to play a substantial role, the present calculation ignores all possibilities of strong π-π effects, and incorporates only those π-π scattering effects required by the consistency of the current algebra approach. The evaluation of these contributions requires some assumptions on the equal-time commutators of pseudoscalar and scalar densities. Finally, suggestions are made on the extensions of the present approach based on resonance models. (auth) (Disser. Abstr.)

52974 CURRENT ALGEBRA, POLE-DOMINANCE AND MESON COUPLING CONSTANTS. II. Csikor, F.; Montvay, I. (Roland Eoetvoes Univ., Budapest). Nucl. Phys., B7: 268-80 (1968).

The Fubini-Halliday-Landshoff-type sum rules are applied in the pole-dominance approximation to current commutators taken between vacuum and vector as well as vacuum and axial-vector states. All the form factors appearing are given in terms of a single parameter. The results are consistent with those of Csikor and Montvay [Nucl. Phys. B5: 492(1968)], and the number of free parameters there is further reduced. (auth)

52975 THE INTERNAL SYMMETRY GROUP $SU_3 \times SU_3$ WITH MINIMAL EXTENSIONS PARITY AND CHARGE CONJUGATION APPLIED TO STRONG MESON DECAY. Moran, William Preston. New York, Univ. of Rochester, 1968. 217p.

Thesis.

An internal symmetry group $\overline{W}_3(S\overline{W}_3)$ containing the continuous group SU_3 and the discrete operators parity and charge conjugation is applied to the strongly interacting mesons and meson resonances. After defining the connection of the discrete operators to the internal symmetry as a minimal extension the structure of such an extension is explored and its intimate connection to the three-field model with parity interchange is displayed. The meson spectrum is then examined to test the ability of the symmetry to classify particles. In the course of this much information to the masses and decays of massive meson resonances is reviewed and extended on very general phenomenological grounds. It is essential to the tests of the group $\overline{W}_3(S\overline{W}_3)$ to have as much information as possible about states of the same spin but different P and C. The group $\overline{W}_3$ $(S\overline{W}_3)$ is applied to the two body decays of the meson resonances. The ratio of exact to broken symmetry couplings was estimated. Good estimates of a large number of decays and many predictions on the decays of spin two and higher particles were obtained. (Diss. Abstr.)

52976 HOMOGENEOUS LORENTZ GROUP PARTIAL WAVE ANALYSIS AND THE ASYMPTOTIC BEHAVIOR OF THE INVARIANT AMPLITUDES FOR $\rho + \pi \to \rho + \pi$ AND $A_1 + \pi \to A_1 + \pi$

PROCESSES AT HIGH ENERGY. Palev, C. (International Centre for Theoretical Physics, Trieste, Italy); Samiullah, M. Z. Phys., 216: 293-9(1968).

A study of the $\rho + \pi \rightarrow \rho + \pi$ and $A_1 + \pi \rightarrow A_1 + \pi$ processes was made in the Delbourgo, Salam and Strathdee homogeneous group partial-wave expansion formalism for arbitrary t. The asymptotic behavior of the helicity amplitudes was given for the leading Regge trajectory. Using this result the asymptotic behavior of the corresponding invariant amplitudes was computed. It was possible to find a unique asymptotic behavior for the invariant amplitudes C and D, and a maximal asymptotic behavior for A and B. The results for the asymptotic behavior of C and D and the maximal behavior of A and B agree with those given by Alfaro et al. (auth)

52977 PION FORM FACTORS IN THE QUARK MODEL. Narita, Takao (Tohoku Gakuin Univ., Japan). Prog. Theor. Phys. (Kyoto), 40: 429-30(1968).

The quark model is applied to the pion charge form factor. The expressions obtained are used to analyze previous data of the positive pion charge form factor. A good fit was obtained and the features indicated by the results are noted. (L.B.S.)

52978 INTEGRAL FORM OF PCAC. Krolikowski, W. (Inst. for Nuclear Research, Warsaw. Univ. of Warsaw). Acta Phys. Pol., 34: 359-64(Aug. 1968).

An integral form of the partial conservation of the axial current (PCAC) is proposed, which gives a link between the axial current and the π and A_1 mesons. Then, making use of the Weinberg sum rules a theoretical estimation is obtained for the coupling constant of the A_1 meson to the nucleon-antinucleon pair. Finally, the decay rate is estimated for $\rho \rightarrow \pi + e + \nu$, taking from experiment the decay rate for $A_1 \rightarrow \rho + \pi$ and using a new relation of the Goldberger–Treiman type. (auth)

52979 EFFECTS OF THE RESONANCE SCATTERING AMPLITUDE AT HIGH ENERGIES. Bando, Masako; Machida, Shigeru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 40: 317-30 (Aug. 1968).

Effects of the direct channel resonances are investigated systematically for high energy hadron scattering. Characteristic behavior of each factor appearing in the correct expression for the resonance scattering amplitude is discussed. Contributions of the resonance scattering amplitude are evaluated, neglecting spin and isospin, for two case of infinite series of the resonance levels of the Chew–Frautschi plot and the case of no resonance other than those established up to the present. Effects of these amplitudes on several processes, such as the real to imaginary ratio of the amplitude for $\bar{p}p$ elastic scattering, the angular distribution for $\bar{p}p$ elastic and charge-exchange scattering and the polarization of the pion-nucleon charge-exchange scattering, are discussed briefly. The calculation seems to show that the effects of the resonance scattering amplitude give results favorable for interpretation of experimental data on these processes. (auth)

52980 REGGEIZED SHORT RANGE POTENTIAL AND RESONANCE WIDTH. Imoto, Michiko (Nihon Univ., Chiba, Japan). Progr. Theor. Phys. (Kyoto), 40: 403-11(Aug. 1968).

By taking account of contributions from the Regge poles in the s and u channels, in addition to a long range potential, a short range potential is introduced into a self-consistent calculation with the strip approximation of low energy π–π scattering. When only the ρ Regge pole is used, the l = 1 wave projection of this short range potential gets attractive and has the effect to complement the potential so as to reproduce the input resonance width. In both cases with and without taking account of the short range potential, the ρ resonance width is numerically calculated. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 53245 and 53248.

52981 VECTOR DOMINANCE SUM RULES FOR MESON–BARYON SCATTERING. Graham, R. H.; Huq, M. (Syracuse Univ., N. Y.). Nucl. Phys., B7: 250-4(1968).

Vector dominance sum rules are written down for invariant amplitudes in πN and $\pi\Sigma$ scattering. They are tested by saturation with resonances in the narrow-width approximation. (auth)

52982 SIMPLE BRANCHING RATIOS AND SUM RULES IN PERIPHERAL REACTIONS. Lipkin, Harry J. (Argonne National Lab., Ill.). Nucl. Phys., B7: 321-9(1968).

Derivations are presented of several experimental predictions which follow either from the additivity quark model or from particle exchange models with broken SU(3). The minimum set of assumptions required to give each prediction is discussed in order to specify exactly which theoretical points are tested in each case by comparison with experiment. (auth)

52983 DATA COMPILATION OF BARYON–BARYON INTERACTIONS. II. PROTON–NEUTRON COLLISIONS BETWEEN 1 AND 27 GeV/c. Alexander, G.; Benary, O.; Maor, U. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., B7: 281-92(1968).

The second part of a data compilation on baryon-baryon interactions is presented, which covers n-p interactions at 1 to 27 Gev/c. The report includes a list of references followed by curves showing the total n-p cross section, the nucleon-nucleon cross section in the isospin I = 0 state ($\sigma^T_{I=0} = 2\sigma^T_{np} - \sigma^T_{pp}$), elastic and charge cross sections and polarization curves at various incoming momenta. Finally a table is given of the total elastic cross-section data. (L.B.S.)

52984 THE PAULI–KUSAKA MIXTURE IN MODERNIZED FORM. Wentzel, Gregor (Univ. of Chicago). Helv. Phys. Acta, 41: 1259-62(1968).

Recent studies, in the static strong-coupling theory, of models with SU(3) symmetry, can be extended so as to include vector with pseudoscalar mesons and thereby make the model more realistic. (auth)

52985 PROCESSES REQUIRING DOUBLE SCATTERING IN THE QUARK MODEL. Dean, Nathan W. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys., B7: 311-20(1968).

Using the quark model and the Glauber multiple scattering formalism the processes are studied involving double charge or hypercharge exchange, which are forbidden in the simple additive quark model. An expression relating the differential cross sections of these processes to those of allowed processes is derived and compared with the limited experimental data available. Despite the rather low energies, the agreement is in most cases quite good within the large errors. (auth)

52986 BOOTSTRAP THEORY OF STATIC PION–BARYON SCATTERING, CONNECTIONS WITH STRONG-COUPLING THEORY. Cronstrom, C.; Noga, M. (Univ. of Helsinki). Nucl. Phys., B7: 201-19(1968).

The baryon mass formulae for isobars, with I = J and I = J ± ½, are derived from a static bootstrap model, on the assumption that the baryon mass-differences are small in comparison with the pion mass. More precisely, only mass differences of the lowest non-trivial order are retained in the calculations. The resulting mass formulas are exactly equal to those which follow from the strong-coupling theory. Some conditions on the parameters in the mass formulas are obtained. In the approximations made, these conditions are inequalities among the parameters which essentially restrict their magnitude. This means that the strong-coupling theory is essentially equivalent to the static bootstrap model in this approximation, since all the results arrived at by virtue of the strong-coupling theory also follow from the static bootstrap model in the limit of small mass differences, for the isobar series mentioned above. (auth)

52987 RADIATIVE CORRECTIONS TO PION–NUCLEON COUPLING CONSTANTS. Morrison, Luther Kent. Seattle, Univ. of Washington, 1967. 125p.

Thesis.

The electromagnetic corrections to the π-N coupling constants were calculated by four methods: Feynman graphs, sidewise dispersion relations, sum rules, and current commutation relations. The results are explicitly shown to be gauge invariant. Only the nucleon intermediate state is considered in the Feynman approach and the dispersion relation approach, but the effect of the N*(1238) intermediate state is estimated in the commutation relation approach. The elastic electromagnetic form factors are used to cut off the integrals for the Feynman graphs and sum rules, and an ultraviolet cutoff is used in the dispersion integrals. The uses of PCAC and quark model current-current commutators for calculating the coupling constant shifts are discussed. Finally a comparison of the various methods is made. (Diss. Abstr.)

52988 DAUGHTER POLE HYPOTHESIS OF N*(1400) AND PHASE SHIFT ANALYSIS OF P_{11} π-N SCATTERING. Yamamoto, Yoshitaka (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 331-8(Aug. 1968).

The Roper resonance, N*(1400), is assumed to be the second daughter of the nucleon trajectory and the low energy P_{11} π-N phase shift is analyzed by applying Khuri's threshold formula to the direct channel nucleon Regge pole and its daughter. The obtained phase shift starts off negative at threshold and changes its sign at $T_\pi \simeq 250$ MeV, a behavior not in disagreement with experiment. This fact is indeed the consequence of the daughter when the parent trajectory contains a stable particle. (auth)

52989 FINITE-ENERGY SUM RULES FOR πN SCATTERING AT u = (1236 MeV)^2. Kayser, Boris (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 21: 1292-5(Oct. 21, 1968).

To test the assumptions which underlie them, four finite-energy sum rules are evaluated for πN scattering. Results are obtained for three choices of end point: $(1356\ MeV)^2$, $(1808\ MeV)^2$, and $(2313\ MeV)^2$. For the intermediate end point all four sum rules work. However, for the highest one they all fail. The results are interpreted as confirming the assumptions of analyticity and Regge behavior, but pointing to the limitations of the resonances-dominance approximation. (auth)

52990 EMPIRICAL FORMULA FOR THE BARYON MASS SPECTRA. Rosen, Gerald (Drexel Inst. of Tech., Philadelphia). Phys. Rev. Lett., 21: 1291-2(Oct. 21, 1968).

A more explicit version of Schwinger's formula is given, and it is observed that the spin-dependent mass splitting between the octuplet and decuplet is governed by the same linear functional form as the isospin-hypercharge-dependent splitting within either unitary multiplet. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 52930.

52991 THE PROBLEM OF LAMBDA-PARTICLE BINDING IN NUCLEAR MATTER. Mueller, G.; Clark, J. W. (Washington Univ., St. Louis). Nucl. Phys., B7: 227-49(1968).

Extensive variational calculations of the binding energy of a Λ particle to nuclear matter are performed in the framework of the Jastrow method, assuming velocity-independent two-body potentials. All cluster contributions of zeroth and first order in the cluster expansion of the expected Λ binding energy B_Λ are evaluated. (The total zeroth-order contribution is the sum of all two-body terms; the total first-order contribution, the sum of all three-body terms plus special four-body terms.) Truncated versions of B_Λ which include first-order contributions are maximized with respect to parameters in the nucleon-Λ correlation factor. The resulting cluster convergence appears very satisfactory in all cases. For the most refined spin-dependent effective central nucleon-Λ potentials (fitting the data on s-shell hypernuclei and Λ-p scattering) the theoretical lower limits obtained exceed empirically determined upper limits on the Λ binding energy by about a factor two. (auth)

52992 ON THE EFFECT OF STRONG Λ-N INTERACTION IN THE NONMESIC DECAY OF LIGHT HYPERNUCLEI. Tamiya, Takanori (Osaka Univ.). Prog. Theor. Phys. (Kyoto), 40: 420-1 (1968).

The nonmesic decay of light hypernuclei is investigated under the assumption that the process takes place through the two-body decay of the hypothetical hyperdeuteron. (W.H.K.)

52993 NUCLEON-NUCLEON TRIPLE SCATTERING PARAMETERS FOR RECOIL PARTICLES. Janout, Z.; Kazarinov, Yu. M.; Lehar, F.; Winternitz, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Czech. J. Phys., 18: 970-6(1968).

Relativistic formulas are obtained, expressing the polarization of the initially unpolarized particle in the scattering of an unpolarized nucleon on a polarized one, in terms of the polarization transfer tensor and in terms of the scattering matrix elements. (auth)

52994 LOW-ENERGY NUCLEON-NUCLEON SCATTERING, CHARGE SYMMETRY, AND CHARGE INDEPENDENCE. Wilson, Richard (Harvard Univ., Cambridge, Mass.). Comments Nucl. Particle Phys., 11: 141-5(Sept.-Oct. 1968).

Recent measurements of the parameters in the effective range expansion of low-energy nucleon-nucleon scattering cross sections are presented. The new results verify the hypothesis of charge independence. (L.B.S.)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 52949, 53081, 53089, 53143, and 53195.

52995 (BMwF-FBK-68-14) NUCLEAR LIE GROUPS AS SYMMETRIES OF A SCATTERING OPERATOR. Westenholz, C. v. (Muenster Univ. (West Germany). Institut fuer Theoretische Physik). Feb. 19, 1968. 31p. (In German). Dep.

A very large class of infinite-dimensional Lie groups is considered in the framework of a phenomenological Lagrangian field theory in order to study symmetries of the scattering matrix. With appropriate restrictions about the mass-operator spectrum the following fundamental physical results are obtained: 1) the S-matrix can only be the trivial one; and 2) without further assumptions as for instance the existence of some finite-dimensional internal symmetry-subgroup of the given "nuclear Lie group" only a trivial coupling between internal and space-time symmetry can be obtained. (auth)

52996 (BMwF-FBK-68-15) NONCOMPATIBLE SYMMETRIES. Loeffler, G. (Muenster Univ. (West Germany). Institut fuer Theoretische Physik). Feb. 22, 1968. 10p. (In German). Dep.

A theorem is formulated; its importance for symmetry-coupling follows from a discussion of some examples: inner and outer symmetries are not simultaneous exact symmetries. The result agrees in the case of Lorentz and isospin invariance with the result of Carruthers and Jin, which was derived with field theoretic methods. (auth)

52997 SYMMETRY GROUPS FOR MULTIPLETS OF PARTICLES OF DIFFERENT MASS. Bacry, H.; Nuyts, J. (Inst. for Advanced Study, Princeton, N. J.). Ann. Inst. Henri Poincare, Sect. A, 7: 333-8(1967). (In French).

It is shown that exact internal symmetry groups [isospin for example] can be defined which take into account mass differences inside each multiplet. Using properties of the space-time dilation operator, the construction of Lagrangians for free fields is derived. (auth)

52998 ON THE REGGE SYMMETRIES OF THE 3J SYMBOLS OF SU(2). Flamand, G. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Ann. Inst. Henri Poincare, Sect. A, 7: 353-66(1967).

The symmetries of the 3j symbols of SU (2) are fitted into a broader group theory framework. The 3j symbols of SU (2) are identified to certain 3j symbols of SU (3). Viewed as SU (3) properties, their Regge symmetries are nothing but ordinary permutation symmetries. (auth)

52999 DISCRETE SYMMETRIES OF ELEMENTARY PARTICLE PHYSICS. Hermann, Robert (Stanford Univ., Calif.). Ann. Inst. Henri Poincare, Sect. A, 7: 339-52(1967).

The discrete symmetries P, C and T are discussed in terms of Lie algebra extensions of the Poincaré Lie algebra. This formulation leads to certain problems of Lie algebra theory which will be presented in this and succeeding papers. (auth)

53000 GENERATING FUNCTIONS AND CHARACTERS OF IRREDUCIBLE REPRESENTATIONS OF SU(3) AND SU(2,1). Biedenharn, L. C.; Gruber, B.; Weber, H. J. (Duke Univ., Durham, N. C.). Proc. Roy. Irish Acad., Sect. A, 67: 1-14 (Sept. 1968).

It is shown for SU(3) that its irreducible representations can be "generated" by a product of three polynomials in two variables x and y. The exponents k_1 and k_2 of a term $C \cdot x^{k_1} y^{k_2}$ of this polynomial determine a weight of the irreducible representation, while the coefficient C gives its multiplicity. It is shown that the same is true for those irreducible representations of SU(2,1) which have a character in the classical sense. The characters given by M. I. Graev(1955) are supplemented with characters which have not been given before. These characters are derived in a heuristic manner and are shown to be in correspondence with irreducible representations of SU(2,1) obtained by L. C. Biedenharn, J. Nuyts and N. Straumann(1965). For all the representations associated with these characters formulas analogous to Kostant's formula are derived. (auth)

53001 RELATIONS BETWEEN "INNER" AND "OUTER" MULTIPLICITIES FOR THE CLASSICAL GROUPS. Gruber, Bruno (Duke Univ., Durham, N. C.). Ann. Inst. Henri Poincare, Sect. A, 8: 43-51(1968).

For the groups SU(n + 1), SO(2n + 1), Sp(2n), SO(2n) and G_2 two relations are derived between the inner multiplicities of the weights contained in irreducible representations forming a direct product and the outer multiplicity of an irreducible representation contained in the Clebsch-Gordan series. The second relation relates the multiplicity of one of the irreducible representations forming the direct product to the outer multiplicity of the Clebsch-Gordan series and is therefore well suited to calculate the outer multiplicity from the inner multiplicity. In the appendix an example is given for SU(3), SU(6) and SU(12), respectively. (auth)

53002 NONDYNAMICAL PARITY TESTS FOR BOSONS AND FERMIONS. Kozlowski, M. (Univ. of Warsaw). Acta Phys. Pol., 34: 191-9(Aug. 1968).

Some parity tests are established for bosons with spin 1 and fermions with spin s, which undergo three-body parity conserving decays of the type: $1 \rightarrow 0 + 0 + 0$, $1 \rightarrow 1 + 0 + 0$ and $s \rightarrow \frac{1}{2} + 0 + 0$. These tests were obtained without any dynamical assumptions about the mechanism of decays of elementary particles. Only the prin-

ciples of invariance which are satisfied by different types of interactions are assumed. (auth)

53003 POSSIBLE DERIVATION OF SOME SO(p,q) GROUP REPRESENTATIONS BY MEANS OF A CANONICAL REALIZATION OF THE SO(p,q) LIE ALGEBRA. Richard, J. L. (CNRS, Marseille). Ann. Inst. Henri Poincare, Sect. A, 8: 301-9(1968).

Starting from the usual realization of the inhomogeneous SO (p − 1, q − 1) algebra in terms of quantum mechanical operators, a realization of the SO(p,q) algebra is obtained by introducing supplementary variables and arbitrary parameters. In this way it is shown how one can derive some representations of the SO (p,q) group ($pq \neq 0$). (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 52917, 52920, and 52929.

53004 (ITEF-583) T NONINVARIANT SPIN CORRELATIONS IN LEPTONIC DECAYS OF BARYONS. Solov'ev, V. V.; Tsukerman, I. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 20p. (In Russian). Dep.

T noninvariant correlations in leptonic decays of baryons ($B_1 \rightarrow B_2 + l + \nu$) are calculated assuming complex form factors and taking into account spins of B_1, B_2, and l particles. All the T noninvariant correlations of different types involving the same spins of two or three particles are shown to be related by lineary equations. Possibility of measuring the correlations and its comparison with the computed values are considered. The results of calculations are also compared with contributions to the T noninvariant correlations which are due to electromagnetic baryon-lepton interaction in final state. (auth)

53005 TIME REVERSAL AND THE K^0 MESON DECAYS. Casella, R. C. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett., 21: 1128-31(Oct. 7, 1968).

It is shown that T is not conserved in the CP-nonconserving $K^0 \rightarrow 2\pi$ decays by direct data analysis (rather than inferentially via CPT) over a considerable range of values for the Wu-Yang parameters within the span of existent data. In particular, if $|\eta_{00}|/|\eta_{+-}| \leq 1.0$, then T is broken. This result is independent of the final state $\pi\pi$ interaction. (auth)

53006 SEEMING TIME-REVERSAL VIOLATION IN HIGHER-ORDER WEAK INTERACTIONS. Leibrandt, G. (Univ. of Guelph, Ont.). Can. J. Phys., 46: 1945-56(Sept. 1, 1968).

It is demonstrated within the framework of the intermediate vector boson theory that the interference between purely weak interaction graphs of different orders in g can lead to a seeming violation of time reversal T. This seeming violation is implied by the presence of triple scalar products in experimental cross sections, $d\sigma \propto DJ \cdot p_1 \times p_2$, and may occur even if the primary weak interaction Hamiltonian is T invariant. The total scattering amplitude for a set of Feynman graphs is characterized by coefficients G_j. A necessary condition for the appearance of time-odd correlations is that the ratio G_i/G_j be complex. The theory is applied to the scattering of a neutron by an incident high-energy neutrino: $\nu_e + n \rightarrow p + e^-$. Triple scalar products are shown to arise specifically from the interference between real and imaginary components of the total amplitude, constructed here from second- and sixth-order uncrossed ladder graphs. The essential imaginary components are divergence-free and emerge from poles in the integrand of the eightfold integral (sixth-order graph). Triple scalar products in $d\sigma$ are proportional to $m^{-6}\, g^8\, (\ln s)/s$; there is no cancellation from crossed graphs of order six. Ladder graphs treated on an individual basis do not give rise to $J \cdot p_1 \times p_2$ terms. (auth)

53007 BREAKDOWN OF CP-INVARIANCE IN WEAK RADIATIVE DECAYS. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 197-208(July 1968). (In Russian).

Examination of the effects of the nonconservation of the CP and T invariances in various interactions did not reveal any generally valid principle to help in the choice of a specific mechanism among those proposed. A phenomenological analysis of the effects of the nonconservation of the CP invariance in weak radiative processes points toward a weak electromagnetic mechanism. This problem was examined on the basis of a miniweak interaction. The results indicated somewhat troublesome alternatives, involving the breakdown of the T invariance in slightly probable processes, or minor, T nonparity correlations in a more probable process. Studies on the radiative decay of K mesons of other authors were further extended. (TTT)

53008 HYPERON NONLEPTONIC DECAY ACCORDING TO THE CP-NONCONSERVING THEORY OF OAKES. Albright, Carl, H. (Northwestern Univ., Evanston, Ill.). Phys. Rev. Lett., 21: 1216-19(Oct. 14, 1968).

The effect of CP nonconservation in hyperon nonleptonic decay is evaluated according to a recent theory of Oakes. Only the ratio β/α for the $\Sigma^{\ddagger}$ decay mode is predicted to show a sizeable effect which, in fact, demands an order of magnitude greater accuracy than has been obtained to date experimentally. (auth)

Applications (Strong)

Refer also to abstract 52935.

53009 (KFKI-17/1968) EXTENSION OF THE SL(2,C) SYMMETRY. Suranyi, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). July 11, 1968. 12p. Dep.

The SL (2,C) trajectory generating algebra is extended to a SL (2,C) × SL (6,C) algebra in a natural way. Axial-, vector- and pseudoscalar meson trajectory families are generated by the same multiplet; the pion is automatically a conspiring particle with Toller quantum number $J_0 = 1$. Generalized SU(6) relations for Lorentz-pole residues are obtained. (auth)

53010 SPINOR SPACE AND STRONG INTERACTIONS. Smrz, P. (McGill Univ., Montreal). Can. J. Phys., 46: 2073-8(Sept. 15, 1968).

In order to explain the existence of internal quantum numbers of elementary particles, the ordinary space-time position vector is assumed to be a bilinear combination of two basic spinors. It is shown that this assumption leads to the replacement of the inhomogeneous Lorentz group by the (4 + 1) de Sitter group. Using the idea of external and internal space for the description of strongly interacting particles, the assumption provides a simple way of introducing the internal symmetries. The internal symmetry group SU(3) appears naturally connected with the external space, yielding the Gell-Mann–Okubo mass formula. (auth)

53011 A COMPOSITE MODEL IN THE THEORY OF THE O(4) SYMMETRY. Nakamura, Seitaro; Sato, Shigeo (Tokyo Univ. Nihon Univ., Tokyo. Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 40: 379-93(Aug. 1968).

A model of the composite structure of particles is suggested from the viewpoint of the O(4) symmetry. The discussion is confined to the kinematical problems. In order to get further prospect for the dynamical aspect of the model, the empirical mass formulas in connection with the breaking interactions of the full symmetry are considered. (auth)

Field Theories

General

Refer also to abstract 52949.

53012 GEOMETRIC APPROACH TO LOCAL GAUGE THEORY. Treat, Richard Perry. Riverside, Calif., Univ. of California, 1967. 100p.

Thesis.

It is shown that the free Yang-Mills equations admit as an exact solution a non-Maxwellian field, singular on a world line, with short-range components which arise from the nonlinearities of the field equations. This field is not considered of direct physical significance since the non-abelian internal holonomy group associated with the gauge fields is non-compact and non-semi-simple, but it demonstrates how the non-abelian property can lead to short-range field components. The electric charge is identified as the asymptotic field, in contradistinction to the algebraic identification which is customary in gauge theory. It is shown that free Yang-Mills fields have a positive definite energy density if the internal holonomy group is semi-simple and compact. Gauge potentials acting in the linear vector space formed by the six generators $L^{\lambda}_{ik}(x^{\mu})$ of local Lorentz transformations were considered. This algebra space is identified as the internal space associated with the internal degrees of freedom of elementary particles. A link between the internal space and the event space is established through the $L^{\lambda}_{ik}(x^{\mu})$: it is similar to the link that exists between the Dirac spin space and the event space through the Dirac operators. The demand of covariant constancy of $L^{\lambda}_{ik}(x^{\mu})$ establishes a map between the parameters of the event connection and the gauge potentials. In the inverse problem the gauge potentials are given and the extent to which the event geometry is then committed is examined. The amount of non-uniqueness of the inverse map is determined by the rank of a matrix M. The Riemannian geometry is always undetermined by an arbitrary constant multiple of the metric field and in exceptional cases continuous families of geo-

metrically different Riemann spaces can correspond to the same field of gauge potentials. The Schwarzschild metric is an example of such a case. By the use of an anholonomic basis in the Riemann space it is shown that discretely different geometries corresponding to the same gauge potentials are excluded if the rank of M is maximum. This result applies also to the inverse map with the spin connection. Gauge fields satisfying the free Yang-Mills equations were considered, while maintaining the link between gauge potentials and event geometry. If the rank of M is maximum the free Yang-Mills equations for gauge potentials in the algebra space or the spin-connection are found to be dynamically equivalent to the free Einstein equations with arbitrary cosmological constant. Internal holonomy groups larger than the Lorentz group were considered. The part of the gauge potentials which produces the enlargement of the holonomy group gives rise to a current that acts as a source of the gravitational field. This combination of gravitational and non-gravitational parts of a field in a somewhat unified manner is achieved at the level of the internal space rather than by a generalization of the Riemannian geometry. The gravitational part is mapped down and appears as the Riemannian geometry in the usual way. (Diss. Abstr.)

53013 EINSTEIN-MAXWELL FIELDS WITH NON-ZERO CHARGE-CURRENT DISTRIBUTION. Goodinson, P. A.; Newing, R. A. (University Coll. of North Wales, Bangor). J. Inst. Math. Appl., 4: 270-5(Sept. 1968).

Space-times admitting an Einstein-Maxwell field with a non-zero charge-current distribution are investigated and necessary and sufficient conditions on the Ricci tensor for such space-times are established. (auth)

Quantum Field Theory

Refer also to abstract 52958.

53014 (LNF-67/1) A NOTE ON THE INFRARED DIVERGENCE. Note No. 343. Greco, M.; Rossi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Jan. 13, 1967. 8p. Dep.

It is shown how the infrared divergence can be eliminated in the matrix element, provided that physically true final states for an experiment involving creation and destruction of charged particles are used. (auth)

53015 BOSON FIELDS WITH THE $:\Phi^4:$ INTERACTION IN THREE DIMENSIONS. Glimm, James (Massachusetts Inst. of Tech., Cambridge). Commun. Math. Phys., 10: 1-47(1968).

The $:\Phi^4:$ interaction for boson fields is considered in three-dimensional space time. A space cutoff is included in the interaction term. The main result is that the renormalized Hamiltonian H_{ren} is a densely defined symmetric operator. In addition to the infinite vacuum energy and infinite mass renormalizations, this theory has an infinite wave function renormalization. Consequently the Hilbert space (of physical particles) in which H_{ren} acts is disjoint from the bare particle Fock Hilbert space in which the unrenormalized Hamiltonian is defined. (auth)

53016 INTRODUCTION TO SPECIAL RELATIVITY. Resnick, Robert. New York, John Wiley and Sons, Inc., 1968. 234p.

After the experimental background associated with the theory of special relativity is presented, relativistic kinematics and dynamics are discussed. The relation between relativity and electromagnetism is examined. Three supplements are included on the geometric representation of space-time, the twin paradox, and the principle of equivalence and general relativity. (B.G.D.)

53017 EXTERNAL FIELD PROBLEM FOR HIGHER-SPIN PARTICLES. Capri, Anton Z. Princeton, N. J., Princeton Univ., 1967. 92p.

Thesis.

The Weinberg field equations for higher spin fields are studied. It is proved that if they are coupled minimally to an external electromagnetic field, they define a field that is local and gives rise to a unitary S-matrix. Indeed, the q-number problem defined by the coupled field equations is reduced to a c-number problem. The c-number problem consists of having to solve the coupled inhomogeneous field equations for a C^∞ function with zero initial or final conditions. In the case of the Weinberg equations, an existence and uniqueness theorem is obtained for the c-number problem. The reduction to the c-number problem is obtained by realizing that the fields are operator-valued distributions. After the field-equations are written in integral form and smeared with a test function f we obtain the relation $\Psi(T_r f) = \Psi_{in}(f)$, where Ψ_{in} is a free field and T_r is a mapping of the test function space onto itself. In the case of spin $\frac{1}{2}$ $T_r f = f + f^* S_r A$ where S_r is the retarded free Green's function and $f^* S_r$ is the convolution of f and S_r. The solution to the field equations is now seen to be $\Psi(f) = \Psi_{in}(T_r^{-1} f)$. The main part of the thesis is concerned with studying the properties of the mapping T_r and a corresponding mapping T_a. Using these mappings, closed form expressions are obtained for the interacting field Green's functions in terms of the free field Green's functions. (Diss. Abstr.)

53018 EIKONAL APPROXIMATION FOR BETHE–SALPETER EQUATION. Domash, Lawrence Harold. Princeton, N. J., Princeton Univ., 1967. 160p.

Thesis.

The nonrelativistic eikonal approximation for high-energy, nearly forward scattering is extended to the Bethe-Salpeter equation by methods adapted directly from the Schrödinger ones. The same results are obtained from a dispersion theory and the Blankenbecler-Sugar equation. Only elastic unitarity is included, but this is satisfied asymptotically at high energies. The main method is the expansion of propagators in the vicinity of the mass-shell. A variational principle is developed to solve the resulting equation. Exact asymptotic $s \to \infty$ behaviors of some modified Born terms, such as those by Blankenbecler-Sugar, are computed. The method is extended to spin $\frac{1}{2}$–spin 0 scattering and to vector interactions. (Diss. Abstr.)

53019 APPROXIMATE SOLUTIONS OF THE BETHE–SALPETER EQUATION AT LOW ENERGIES. Connell, John Henry. Seattle, Univ. of Washington, 1967. 83p.

Thesis.

A method of finding successive approximations to the solution of the Bethe-Salpeter equation for low energy interactions is described. It is based upon work of Blankenbecler and Sugar and can be applied to nucleon-nucleon interactions. The method works because of the good accuracy of potential theory in interactions of this type. Potential theory is defined by the method and its validity and limitations are described. Elementary applications of the method to the Wick-Cutkosky and QED Bethe-Salpeter equations are given. The wave functions of the method of this thesis are related to those of the usual potential theory in a simple manner. Also, two side results are included about the QED electron-positron Bethe-Salpeter equation in the ladder approximation with arbitrary covariant gauge constant. (i) The iteration solution to the equation converges when the total centre-of-mass energy lies in a certain domain of the complex plane which includes zero. (ii) The equation can be written as a second order partial differential equation in momentum space. (Diss. Abstr.)

53020 STATUS OF QUANTUM ELECTRODYNAMICS. Drell, Sidney D. (Stanford Univ., Calif.). Comments Nucl. Particle Phys., 11: 136-40(Sept.-Oct. 1968).

A review is given of the status of quantum electrodynamics. New experimental results and analysis of fine-structure splitting in hydrogen and the gyromagnetic ratio of free electrons and muons are discussed. (L.B.S.)

53021 SPECTRA OF MASSLESS AND ZERO ENERGY-MOMENTUM SOLUTIONS OF THE BETHE–SALPETER EQUATION. Naito, Seiichi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 412-19(Aug. 1968).

The Bethe-Salpeter equation for two spinless particles interacting through a massive scalar field is considered. It is shown in our model that a massless bound state exists for any zero-energy-momentum eigenvalue of the coupling constant. Furthermore, the connection between massless and zero energy-momentum amplitudes is investigated in some detail. (auth)

Gravitation and General Relativity

Refer also to abstracts 52346 and 52382.

53022 (IFVE-STF-67-54-K) A COVARIANT FORMULATION OF DIFFERENTIAL "LAWS OF CONSERVATION" IN GEOMETRICAL THEORY. Folomeshkin, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1967. 19p. (In Russian). Dep.

A covariant method of the infinitesimal displacements in a Riemannian space is formulated. A system of equations for canonical tensors defining a closed system is obtained. The equations are the covariant generalization in case of non-Euclidean space of the usual differential conservation laws. The gravitational part of the obtained canonical energy-momentum tensor T_i^k is equal to the symmetric energy-momentum tensor of a gravitational field. The matter part is connected with the symmetric energy-momentum tensor of matter by the identity being a covariant generalization of the Rosenfeld-Belinfante relation. When passing to flat space the tensor T_i^k turns into the usual canonical energy-momentum tensor of matter. For the case of a free gravi-

tational field the obtained equations coincide with the Bianci identities and the Einstein equations. (auth)

53023 (KFKI-23/1968) 3-DIMENSIONAL "RELATIVITY" FOR AXISYMMETRIC STATIONARY SPACE-TIMES. Perjes, Z. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Sept. 3, 1968. 9p. Dep.

The equivalence of the axisymmetric stationary vacuum gravitational field problem to a 3-dimensional "relativity theory" in the presence of a certain scalar matter field is shown. An invariant classification can be achieved with respect to the algebraic structure of the 3-dimensional trace-free Ricci-tensor. The extension of these results to electrovac spaces is also discussed. (auth)

53024 QUANTUM THEORY OF GRAVITATION AND LOCALITY POSTULATE. Kraus, K. (Univ., Marburg, Ger.). Commun. Math. Phys., 9: 339-46(1968).

A quantized space-time metric $g_{ik}(x)$ is investigated within a suitably modified axiomatic approach. Coordinate distances dx are called absolutely spacelike if $g_{ik}(x)\,dx^i dx^k$ is negative definite. For such distances, fields are assumed to commute or anticommute, respectively (generalized locality). The quantum fluctuations of the light cone $g_{ik}(x)\,dx^i dx^k = 0$ are shown to extend to distances dx which are space-like with respect to the Minkowski metric. Generalized locality is therefore weaker than the usual locality postulate. (auth)

53025 CONFORMAL TENSOR DISCONTINUITIES IN GENERAL RELATIVITY. Shepley, L. C. (Univ. of Texas, Austin). Commun. Math. Phys., 9: 313-26(1968).

The postulate is made that across a given hypersurface N the metric and its first derivatives are continuous. This postulate is used to derive conditions which must be satisfied by discontinuities in the Riemann tensor across N. These conditions imply that the conformal tensor jump is uniquely determined by the stress-energy tensor discontinuity if N is non-null (and to within an additive term of type Null if N is lightlike). Alternatively, $[C^{\alpha\beta}{}_{\gamma\delta}]$ and [R] determine $[R_{\mu\nu} - \frac{1}{4} R g_{\mu\nu}]$ if N is non-null. These relationships between the conformal tensor and stress-energy tensor jumps are given explicitly in terms of a three-dimensional complex representation of the antisymmetric tensors. Application of these results to perfect-fluid discontinuities is made: $[C^{\alpha\beta}{}_{\gamma\delta}]$ is of type D across a fluid-vacuum boundary and across an internal, non-null shock front. $[C^{\alpha\beta}{}_{\gamma\delta}]$ is of type I (non-degenerate) in general across fluid interfaces across which no matter flows, except for special cases. (auth)

53026 SINGULARITIES IN THE SPACETIME OF GENERAL RELATIVITY: THEIR DEFINITION, EXISTENCE, AND LOCAL CHARACTERIZATION. Geroch, Robert Paul. Princeton, N. J., Princeton Univ., 1967. 177p.

Thesis.

The arguments that lead from the intuitive picture of a singularity as "some quantity's becoming infinite" to the notion of geodesic completeness are traced. Even within the framework of geodesic completeness there is still a great variety of possible definitions from which to choose. It is argued that none of these definitions is entirely satisfactory. The various theorems are considered establishing that, without any assumptions of symmetry, singularities are present in large classes of solutions of Einstein's equations. The basic concepts and definitions are reviewed which are necessary in order to formulate the theorems. The theorem of Penrose and several of the theorems of Hawking are stated, and their implications are briefly discussed. One new theorem on the existence of singularities is proved. Several global properties of spacetimes are established. It is shown that if (1) the strong principle of equivalence, (2) certain local experiments on symmetry-breaking interactions in the elementary particle domain, and (3) the CPT theorem are accepted, then spacetime must be orientable. It is proved that in principle the topology of spacelike sections in a spacetime may change in an arbitrary way from one epoch to another but that, under certain conditions, such changes are necessarily accompanied by closed timelike curves. The applications of covering manifolds to Einstein's theory in general, and to singularities in particular, are discussed. A new approach to singularities is formulated: their local description. Given any incomplete spacetime M, a topological space, the "g-boundary," is defined whose points consist of equivalence classes of incomplete geodesics of M. The points of the g-boundary may be thought of as the "singular points" of M. Local properties of the singularity may now be described in a well-defined way in terms of local properties of the g-boundary. Two applications of the g-boundary outside of the realm of singularities are discussed. The application of the g-boundary technique to singularities is illustrated with a number of examples. The g-boundary structure of one particular example leads to the consideration of non-Hausdorff spacetimes. The occurrence of singularities presents difficulties of principle for general relativity. These difficulties and various proposals as to how to deal with them are briefly reviewed. (Diss. Abstr.)

53027 GRAVITATIONAL INTERACTIONS. Stanyukovich, K. P. (All-Union Astronomical and Geodetic Society, Moscow). Solar Syst. Res. (USSR) (Engl. Transl.), 1: 107-16(July-Sept. 1967).

The development of various aspects of the theory of gravitation is discussed within the frame-work of the general theory of relativity, group theory, and the theory of compensating fields. According to hypothesis, the gravitational interaction is a consequence of an irreversible emission of energy (rest mass) by the so-called elementary particles. This emission has the character of electromagnetic fluctuations and its quanta may be referred to as gravitons. An account is given of the cosmological consequences of the generalized physical theory of gravitation which includes generalized relativity theory as a special case and is based on the variation of the so-called world constants with the curvature of our own closed universe. The latter is considered to have finite dimensions and lifetime, and is supposed to be included in an infinite universe as one of a denumerable set of special formations. Galaxies, stars, and elementary particles are metastable formations which appeared and continue to appear during the interaction of fundamental particles belonging to different classes, resulting in the creation (at the present time) of 10^{-45} g/cm^3 sec of new matter in the metagalaxy. Elementary particles may be identified as the observed part of a planckion, most of whose mass lies inside the gravitational radius. Large masses and energies can be removed from a planckion by external disturbances and this may result in the creation of hyperons and resonons. The unobservable mass of the metagalaxy must be higher by a factor of 10^{20} than the observable part. This unobservable mass and energy is in fact the Dirac and electromagnetic (gravitational) vacuum, but it is not infinite; when the gravitational field is taken into account it has an enormous but finite energy. (BBB)

53028 CONDITIONS OF MATCHING IN GENERAL RELATIVITY. Bel, Luis; Hamoui, Adnan (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A, 7: 229-44(1967). (In French).

The problem of matching, in the sense of Lichnerowicz, two Riemannian metrics of normal hyperbolic type is considered. The true unknowns of the problem and the degree of arbitrariness involved in its solution, whenever it exists, are precised. A general program permitting to decide on the possibility of matching two metrics is established. This program is applied to a spherically symmetric class of solutions of Einstein's field equations corresponding to a normal material-energy tensor, and it is shown that all such solutions can be matched with Schwarzschild's exterior solution provided that the radial pressure vanishes on a time-like hypersurface. (auth)

53029 FIELD EQUATIONS IN THE NEIGHBOURHOOD OF A PARTICLE IN A CONFORMAL THEORY OF GRAVITATION. Islam, J. N. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 306: 487-501(Sept. 24, 1968).

The field equations in the neighborhood of a particle for a spherically symmetric metric in the conformal theory of gravitation put forward by Hoyle and Narlikar are examined in detail. This metric is assumed to be of the usual form $ds^2 = e^{\lambda}dt^2 - e^{\nu}dr^2 - r^2(d\theta^2 + \sin^2\theta d\Psi^2)$ where λ and ν are functions of r only. Hoyle and Narlikar obtained a solution of the field equations under the assumption $\lambda + \nu = 0$. The case $\lambda + \nu \neq 0$ is investigated, and it is shown that the only solution that satisfies all the boundary conditions is the special solution obtained by setting $\lambda + \nu = 0$. The significance of this result is discussed. (auth)

53030 STUDY OF THE KERR METRIC. Leaute, Bernard (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A, 8: 93-115 (1968). (In French).

The Kerr metric is a stationary axially symmetric solution of Einstein vacuum equations; it depends two parameters m and a. It is shown that m can be interpreted as the mass of the central body which is the source of the field—Gauss' theorem—and—m/a as a "mass current" travelling inside the body—Ampère's theorem—. The study of the multipole structure of the Kerr field reveals a "quadrupole mass moment" proportional to ma^2, and a "dipole moment of rotation" proportionnal to ma. By considering the trajectories of test particles, the existence of a term proportional to a is revealed which does not exist in the Schwarzchild solution. (auth)

53031 PURE RADIATION FIELDS IN GENERAL RELATIVITY. Misra, M. (Gujarat Univ., Ahmedaba, India). Ann. Inst. Henri Poincare, Sect. A, 7: 245-7(1967).

A method for generating pure radiation fields from empty gravitational fields is given. (auth)

53032 STIMULATED PHOTON-GRAVITON CONVERSION BY AN ELECTROMAGNETIC FIELD. Halpern, L. (Univ., Paris); Jouvet, B. Ann. Inst. Henri Poincare, Sect. A, 8: 25-42(1968).

The stimulated photon-graviton conversion in a photon field is studied by exact calculation of convenient propagators. Thereby the difficulty of infrared divergences which occur in the perturbation expansion in the limit of low energy stimulating photons is resolved. The solutions for various frequencies of the stimulating photons are compared with the results of the perturbation expansion. (auth)

Scattering Theory

Refer also to abstracts 52949, 52995, 53230, and 53240.

53033 HIGH-ENERGY SCATTERING BY A SUPERPOSITION OF TWO POWER POTENTIALS. Fluegge, S.; Krueger, H. (Univ., Freiburg i. B.). Z. Phys., 216: 213-28(1968).

For a superposition of two power potentials the scattering amplitude and the total cross section are evaluated making use of the high-energy formula derived by Blankenbecler and Goldberger. The scattering amplitude is expressed by a finite sum of impact-parameter pole contribution in analogy to Regge poles in the angular momentum plane. It is shown that each pole contribution can be expressed in terms of known functions. Furthermore the large momentum transfer asymptotics of an impact parameter pole is investigated in detail. (auth)

53034 CONDITIONS THAT MUST BE SATISFIED BY CROSSING-SYMMETRIC FINITE-ENERGY SUM RULES. Atkinson, D.; Dietz, K.; Honerkamp, J. (Univ., Bonn). Z. Phys., 216: 281-92 (1968).

It is shown that there can be no exact solution of a crossing-symmetric finite-energy sum rule in terms of a finite number of towers of zero-width resonances. If the Regge behavior in a channel is to come from the resonances in the same channel, and not from some background term, there must either be appreciable overlap of broad resonances, or an infinite number of Regge trajectories. If complete crossing-symmetry is to be achieved, Regge cuts, as well as poles, must be incorporated. The above statements are supported by mathematical models; and the conclusion is that finite-energy sum-rule bootstrap calculations with a finite number of towers of resonances should be treated with extreme caution, for they can, at best, be only very approximate. (auth)

53035 COMPLEX HIGHER-ORDER POLES AND GENERALIZED UNSTABLE PARTICLES. Lukierski, J. (Univ. of Wroclaw). Acta Phys. Pol., 34: 247-55(Aug. 1968).

The generalization of Peierls description of unstable particles by means of complex poles of higher order is introduced. The restrictions on the parameters (the position of complex poles, the residua) following from the positive definite mass spectrum and two-particle unitarity condition are given. The generalized unstable particles can be used to describe the resonances with much more arbitrary shape of the mass spectrum than the one given by the Weisskopf-Wigner formula. In particular, the shape can be unsymmetrical. (auth)

53036 REFLECTION SYMMETRY OF CONSPIRING FERMION TRAJECTORIES. Kanki, Takeshi (Osaka Univ.); Konisi, Gaku; Saito, Takesi. Progr. Theor. Phys. (Kyoto), 40: 394-402(Aug. 1968).

It is shown by making use of the analytic property of the Khuri amplitude near W = 0, W being the c.m. energy of πN scattering, that two fermion trajectories $\alpha^{\pm}(W)$ as well as their reduced residues $\bar{\beta}^{\pm}(W)$, with parity $\pm$ and with the same signature, are related with each other by reflection of their argument W, i.e. $\alpha^{+}(W) = \alpha^{-}(-W)$, and $\bar{\beta}^{+}(W) = \bar{\beta}^{-}(-W)$. This symmetry cannot be obtained from the analytic property of the partial-wave amplitude contrary to the conventional assertion. (auth)

53037 FOURIER INTEGRAL REPRESENTATION FOR SCATTERING AMPLITUDE. Arushanov, G. G. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 1, 24-7(1968). (In Russian).

The integral representation for the scattering amplitude is much simpler and more convenient to apply than the usual decomposition of the amplitude into Lagrangean polynomial series. This problem was investigated, considering the Fourier representation for the scattering amplitude. The formalism derived may be used for any physical energy and scattering angle. If the scattering amplitude is imaginary, as it may be at very high energies, the unitary system may be expressed in a simplified manner. Several specific asymptotic relations are examined. (TTT)

Particle Accelerators

Refer also to abstracts 51935, 52243, 52924, 52949, 53169, and 53393.

53038 (AD-667906) ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS. Triannual Report No. 3, August 1-November 30, 1967. Ettenberg, Morris (City Coll., New York). Mar. 1968. Contract DAAB07-67-C-0159. 27p. (ECOM-0159-3). CFSTI.

The detailed design for an end fire experimental gun was completed. All the parts have been machined and only final assembly remains to be accomplished before vacuum testing. The computer program for trajectory plotting including space charge effects has been completed. A sample computer calculation is included as an appendix. (USGRDR)

53039 (BNL-12828) Q MEASUREMENTS ON SUPERCONDUCTING CAVITIES AT S-BAND. Hahn, H.; Halama, H. J.; Foster, E. H. (Brookhaven National Lab., Upton, N. Y.). [1968]. 5p. (CONF-680621-7). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

Q measurements were made on a TE_{011} microwave cavity resonant at 2.87 GHz and constructed of superconducting deflectors made of lead electroplated on OFHC copper. Experimental results for the temperature dependence of the surface impedance of superconducting lead at constant frequency and low power levels are presented. (W.H.K.)

53040 (BNL-12841) IRON SHIELDING FOR AIR CORE-MAGNETS. Blewett, J. P. (Brookhaven National Lab., Upton, N. Y.). [nd]. 13p. (CONF-680621-12). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

The use of iron shielding for removing the high external magnetic fields around air-core superconducting magnets is considered. The field distribution around coils of infinitesimal thickness is treated and extended to coils of finite thickness. Field patterns for dipole fields and quadrupole fields are shown. Iron cross sections are discussed, and the distribution of stored energy in the various regions is approximated. (W.H.K.)

53041 (BNL-12846) DESIGN PROBLEMS IN SUPERCONDUCTING Rf BEAM SEPARATORS. Halama, H. J. (Brookhaven National Lab., Upton, N. Y.). [1968]. 17p. (CONF-680621-13). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

Problems in the design of an rf beam separator which employs two superconducting cavities are discussed. The effects of operating frequency, improvement factor, and peak field on the design of a separator are considered. Optimization of the deflector including structure and stability considerations is described. A block diagram of the microwave system is included. (W.H.K.)

53042 (BNL-12889) AC LOSSES IN MAGNETS MADE OF Nb_3Sn RIBBON. Morgan, G. H.; Dahl, P. F. (Brookhaven National Lab., Upton, N. Y.). [1967]. 9p. Dep. CFSTI.

Experiment results of a study of the ac losses in magnets made of commercially available $\frac{1}{2}$ in. wide Nb_3Sn ribbons are summarized. A comparison with theory is also presented. (B.G.D.)

53043 (IFVE-SKU-67-56-K) PRELIMINARY GROUPING OF IONS IN A HIGH-CURRENT LINEAR ACCELERATOR WITH A LOW-ENERGY OF INJECTION. Enal'skii, V. A.; Osipov, V. V.; Fedotov, A. P.; Shembel, B. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1967. 14p. (In Russian). Dep.

High-intensity proton beam bunching in a linear accelerator with low injection energy is analyzed by means of a mathematical model. A large value of the bunching factor was obtained for a large modulating signal in the klystron-type buncher. An effective capture in synchronous acceleration was confirmed for the bunch with increased initial velocity dispersion. (auth)

53044 (LA-tr-68-46) LITHIUM ION SOURCE. Bretonneau, P.; Dumail, M. Translated by T. Watt for Los Alamos Scientific Lab., N. Mex., from Nucl. Instrum. Methods, 33: 167-8(1965). 9p. Dep. CFSTI.

Design of a thermionic emission lithium ion source which is fitted to a 4-MeV electrostatic accelerator is presented. Preparation of β-eucryptite filaments is also described. (W.H.K.)

53045 (N-68-12929) A HIGH-PRESSURE MAGNETIC ION SOURCE. Final Report. (Perkin-Elmer Corp., Pomona, Calif.). July 1967. Contract NAS5-3453. 91p. (NASA-CF-91381). CFSTI.

A theoretical analysis developing the design equations for extending ion source operation to higher pressures has resulted in a test model capable of direct analysis of pressures up to 1×10^{-2} torr. Close agreement between the theory and the test results was obtained, and the operating pressure range of the test model was extended to 1×10^{-1} torr. The objective of the study was to produce a source capable of operation at 1×10^{-2} torr having a sensitivity of 1×10^{-8} amperes/torr without exceeding a time response of 0.030 seconds. Test of the instrument gave operation to 1×10^{-1} torr with a sensitivity of 8×10^{-9} amperes/torr. The time response was analyzed using a computer program, and for the defined interfacing system gave a response of .0025 seconds to 95% of a stepped pressure change. (auth) (STAR)

53046 (ORO-3491-9) THREE-DIMENSIONAL ELECTROLYTIC TANK MEASUREMENTS. Zinneman, Thomas E. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jan. 1968. Contract AT(40-1)-3342. 17p. Dep. CFSTI.

The feasibility of electrolytic-tank measurements in three dimensions was investigated. Studies were carried out with a parallel-plate model, a cylindrical-tank model, and a thin-gap, two-dimensional electrode system for all of which the potential distribution is known theoretically. It was found that the accuracy of the measurements depended upon frequency, current density through electrolyte, probe geometry, and electrode geometry. Accurates of ±0.5% and better were easily obtainable; however, the error increased when the probe approached electrodes in regions of high field gradients. (auth)

53047 (RHEL/R-162) NIMROD OPERATION AND DEVELOPMENT QUARTERLY REPORT, OCTOBER 1–DECEMBER 31, 1967 Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Feb. 1968. 24p. Dep. CFSTI. UK 4s. 0d.

The Nimrod beam was on for High Energy Physics Research for 80.94% of H.E.P. scheduled operating time. Two experiments were completed, two continued through, and four commenced in this quarter. Some notes on the operation of the X1 and X2 extracted proton beams are given. Radiation dosimetry associated with Nimrod is discussed. Construction of the X2 secondary beam complex is described. A report on the first operational run of the 80 cm Helium Bubble Chamber is included. (auth)

53048 (RHEL/R-163) CALCULATION OF PERTURBED ORBITS FOR RESONANT EXTRACTION FROM NIMROD. Ranft, J. (Rutherford High Energy Lab., Chilton (England)). Apr. 1968. 53p. Dep. CFSTI. UK 8s.

Various techniques of initiating 2/3 resonant extraction from Nimrod are studied. Different types of magnetic field perturbation, and different methods of driving the whole beam into resonance, are examined and compared. Criteria such as the minimization of beam divergence spread in the septum magnet and tolerances on the various parameters lead to a recommended scheme: a continuous field perturbation derived from poleface windings in all the Octants (first harmonic sin 2θ azimuthal variation, and quadratic radial variation) and a driving term obtained from a time-varying magnetic field bump provided by special windings outside the septum. (auth)

53049 (SLAC-90) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, April 1–June 30, 1968. (Stanford Linear Accelerator Center, Calif.). Aug. 1968. Contracts AT(04-3)-400; AT(04-3)-515. 66p. Dep. CFSTI.

Development and operation of the SLAC 20-GeV electron linear accelerator and experimental facilities are discussed. Instrumentation and control, radiation detectors, plant engineering, klystron studies, mechanical engineering, and counting electronics are described. (W.H.K.)

53050 NOTRE DAME'S NEW ACCELERATOR: 1968. Lubozynski, Michael (Notre Dame Univ., Ind.). Notre Dame Sci. Quart., 6: 15-16(Mar. 1968).

The new accelerator being installed at Notre Dame Univ. is a 15-MeV tandem Van de Graaff particle accelerator. It is the first model FN High Voltage Engineering accelerator to have the capability of accelerating both electrons and protons. A tandem Van de Graaff involves using the high voltage produced by the Van de Graaff electrostatic accelerator twice to accelerate the particles. A description of the process for H ions is given. Protons with 15 MeV can be produced. The ion source for Notre Dame's new accelerator will also be able to produce He ions with an energy of 22.5 MeV. The accelerator will also have the capability of accelerating electrons as does the existing 4.5-MeV electrostatic accelerator at Notre Dame. Project research of several faculty members is described. (BBB)

53051 CONTINUOUS OR PERIODICAL CONTROL OF FIELD HOMOGENEITY. von Arx, Arnold. pp 85-8 of Symposium on High-Energy Electrons, Montreux (Switzerland), 7–11 September, 1964. Zuppinger, A. (ed.). New York, Springer-Verlag, 1965. See CONF-640918.

For a circular accelerator the vertical field flattening of electron beams involves problems similar to those of the flattening of its x-ray beams. On the other hand the horizontal field equalization depends on the specific extraction parameters. For betatrons with extraction coils the adjustment to a maximum of intensity results in a reproducible field distribution. A periodical control of the complete field equalization is sufficient. To simplify the operation of a betatron the direct measurement of the horizontal field homogeneity by means of a differential radiation detector is useful, whereby the value of the measurement is used as a criterion for the manual adjustment of the extraction pulse amplitude or for feeding a fully automatic regulation device. For a maximum of precision the integral difference of the left/right dose is measured and introduced into the regulation. (auth)

53052 DC ELECTRIC CONDUCTION OF POLYETHYLENE. Tanaka, Toshikatsu (Central Research Inst. of Electric Power Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku, No. 66029, 1-21(Aug. 1966). (In Japanese).

A study was made on the electric-conduction phenomena in the wide range from a low to a high electric current up to dielectric breakdown for polyethylene, and on their relation with the (polyethylene) structure. To induce changes in the structure, polyehtylene was irradiated with high-energy electrons. (1) Faint current measuring device: Faint currents (10^{-13} A) when a low voltage is applied to the sample material, can be measured by eliminating various noises, and also currents up to dielectric breakdown. (2) Changes in the structure of polyethylene, induced by the irradiation: When polyethylene is irradiated in air with electrons, transvinylene is produced. When left in the atmosphere, the carbonyl radical is formed by the combination with atmospheric oxygen and radiation-induced free radicals. That is, the double-band density is increased by irradiation. (3) Phenomena of electric conduction: The V-I characteristic in terms of voltage is of the three regions, viz., Ohm's law, space-charge limiting current, and rapid current-increase with applied voltage, regions. The electric conduction increases with applied dosage in the low-current region, and the current activation energy is changed by the dosage. (4) Relation between the structure and electric conduction: Such double band as in the transvinylene or carbonyl radical possesses π electrons, thereby able to supply considerable free electrons. From the change in electric conduction, the double bonds are considered as serving the purpose of donor. (auth)

53053 S-BAND RECTANGULAR WAVEGUIDE NETWORK AND COMPONENT PARTS (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1775).

6 drawings.

The network and components which are described function to conduct the microwave power from each of the klystron tubes to the Stanford Linear Accelerator tube. A directional coupler, pump-out subsection, penetration waveguide, spoolpiece and the waveguide valve are included. (For details see TID-4100 Suppl. 48) (F.S.)

53054 MAGNET MEASUREMENT ROTATING COIL DRIVE (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1776).

9 drawings.

The magnet measurement rotating coil drive which is described is also referred to as a "Scotch yoke mechanism." The drive is used at the Stanford Linear Accelerator to drive an induction coil in the core of a reference magnet to measure its field strength. Information from the measurement is fed into a computer that controls the field strength settings for the bending magnets in the beam switchyard. (For details see TID-4100 Suppl. 48) (F.S.)

53055 300 MeV ELECTRON LINEAR ACCELERATOR OF TOHOKU UNIVERSITY. Torizuka, Yoshiharu; Kojima, Yuzo (Tohoku Univ., Sendai). Oyo Butsuri, 37: 690-701(Aug. 1968). (In Japanese).

A 300-MeV electron linear accelerator has been constructed at Tohoku University. Last May, the first accelerated beam was obtained after four years of construction period, and the accelerator has been operated stably for 2000 hours during the past year. The energy spectrum of the beam is satisfactory and a beam current of 60% of the designed value has been attained. After the historical process of construction is described, the general description of the accelerator and some detailed statements of each part of the accelerator are given. The beam characteristics are shown, and experimental results of nuclear research are described. (NSA of Japan)

53056 THE MOST POWERFUL ACCELERATOR IN THE WORLD. Gershtein, S. S.; Logunov, A. A.; Sulyaev, R. M. (Inst. of High Energy Physics, Serpukhov, USSR). Priroda, No. 11, 12-25 (Nov. 1967). (In Russian).

The 70-GeV accelerator at the High Energy Physics Institute at Serpukhov is described. The elementary interactions are considered, with examples for each of 4 types. A periodic system for hadrons is described: an octet for baryons of spin $\frac{1}{2}$, a decuplet for spin $\frac{3}{2}$, an octet for spin 0, a nonet for spin 1. Regge trajectories for several of these systems are introduced, and the notion of quarks as fundamental particles is fit to the systems. A description of the Serpukhov accelerator is illustrated with photographs and a schematic plan. Focusing allows a particle current of 100 mA. There are 120 magnet units of 10,000 Oe, and the radius of the particle path is about 230 m; particles enter the accelerator at 100 MeV and are raised to 70 GeV in 2.6 sec. Total current in the magnets is 10,000 A; the magnet assembly weighs 20,000 tons. Pulses of 10^{12} 70-GeV protons can be produced. Possible experiments include studies of resonances, interactions of K and π mesons with small nuclei, double beam experiments with mesons and antiprotons, and others. Features of various types of detection systems are described. (BBB)

53057 SHIMADZU 32-MeV MEDICAL BETATRON. Toriyama, Hideaki; Hattori, Hiroyuki (Shimadzu Seisakusho Ltd., Japan). Shimazu Hyoron, 24: No. 2, 27-36(June 1967). (In Japanese).

In March 1967, the development of two new 32-MeV medical betatrons for cancer therapy was completed. One was installed at the Kyushu University Hospital, and another is being installed at the Kyoto University Hospital. This kind of betatron is the smallest and the lightest of all the 30 MeV-class betatrons. Other features of this machine are stable output, easy operation and quick installation. The obtained radiation output is more than 90 R/min at the iso-center for x-rays and more than 1500 R/min for electron beams. (auth)

53058 VACUUM FLANGE AND GASKET (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1777).

3 drawings

A vacuum crush seal, flange, and gasket are described. This equipment is used as a transition coupling between the klystron tubes and the S-band waveguide network in the Stanford Linear Accelerator. (For the S-band waveguide network see CAPE-1775). (For details see TID-4100 Suppl. 48) (F.S.)

53059 EVALUATION OF THE EFFECT OF THERMAL VELOCITIES IN ELECTRON BEAMS. Bakhrakh, L. E.; Medoks, V. G. Radiotekh. Elektron., 13: 877-81(May 1968). (In Russian).

In a previous paper (Rad. i elektronika 7: 1, 120(1962)) the defocusing force due to the initial transverse thermal velocities of electrons was added to the equation of travel of boundary electrons. This force was treated as a thermal pressure (per one electron) of the electron gas applied to the beam surface. The force was equal to $2kT/R$ for cylindrical beam and kT/Y for ribbon beam; here, k—Boltzmann constant, T—absolute temperature, R and Y—effective radius and half-width of the cylindrical and ribbon beams, respectively. Although the allowance for this force generally ensured good agreement with experimental data, a noticeable discrepancy was observed in the cases of beam section remote from the cathode. Hence, the method is improved in the present article by taking into account the variation of space-charge density over the beam cross-section caused by the Maxwellian distribution of transverse speeds of electrons emerged from the cathode. More accurate integral formulas for charge density are derived, which can be used for (computer) estimation of the mean defocusing force. A numerical example shows that this force is essentially dependent on R and Y. It is found that, in the case of magnetic focusing of the beam, the use of more accurate formulas is not warranted. (ATD)

53060 THERMAL-VELOCITY EFFECT IN THE FOCUSING OF A TUBULAR ELECTRON BEAM BY A UNIFORM MAGNETIC FIELD. Bakhrakh, L. E.; Kozel, I. A.; Rozhkov, V. M. Radiotekh. Elektron., 13: 882-7(May 1968). (In Russian).

On the basis of a simplified L. E. Bakhrakh method (Rad. i elektronika 7: 4, 656(1961)), the effect is evaluated of the transverse thermal velocities of electrons on the geometry of a hollow cylindrical electron beam focused by a uniform longitudinal magnetic field. The travel of boundary electrons of the beam is considered, and the conditions are determined which ensure simultaneously the minimum waviness of both the outer and inner boundaries of the beam. It is assumed that the electron travel is laminar, the space-charge density over the beam cross-section is constant, and the axial speed of electrons is constant; the boundary ripple wavelength is much greater than the beam diameter. Depending on the particular case, the thermal-velocity effect may be substantial; thus, for $\chi = 0.5$, $I/U^{\frac{3}{2}} = 5 \times 10^{-5}$ amp/$v^{\frac{3}{2}}$, $\tau_c = 0.5$, $r_{re} = 1.2 \times 10^{-3}$ m, B = 0.01 tesla, T = 1100K, the ratios of equilibrium radii estimated with and without an allowance for the thermal velocities are: 1.14 for the outer boundary and 0.81 for the inner; here χ-cathode-shielding degree, $\tau_c = r_{ri}/r_{re}$, i.e., the ratio of inner cathode radius to outer cathode radius. (ATD)

53061 APPLICATION OF H-SHAPED RETARDING SYSTEMS IN THE SYNCHROTRON WAVEGUIDE. Gos'kov, P. I. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 148-50(1968). (In Russian).

By using an H-shaped waveguide it is possible to increase the operating wavelength by 10 to 15% with an unchanged magnetic gap, or to decrease the magnetic gap with an unchanged wavelength λ. Since small magnetic gaps are required in the region of high energies (2 to 3 cm in the GeV region), the design of an H-shaped, ladder system is presented that can be used at wavelengths of 10 to 100 cm (the most suitable region from the point of view of available high-frequency power sources). The working wavelength in the waveguide is determined by twice the height of the dowel inserts, while the interaction space (the distance between the rungs), which is equal to the magnetic gap, has a slight effect only on the transmission width. A ladder system with a distance of 20 to 30 mm between the rungs can operate both in the millimeter and decimeter region of wavelengths. It is desirable to use this ladder system in combination with an iron-free, magnetic system, where the current busbars can be used directly as the rungs. In this case screening of the rapidly-changing magnetic field is completely absent, and the accelerating system can be considerably simplified. Dispersion properties of these types of systems are presented. (TTT)

53062 SHIELDING PROBLEM WITH LOW-ENERGY PARTICLE ACCELERATORS. Burrill, E. Alfred Nucl. Safety, 9: 457-66(Nov.-Dec. 1968).

A basis for establishing the shielding requirements for low-energy accelerators is outlined. The electrical parameters and the end use of the accelerated beam are seen to play important roles. (W.H.K.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 53166, 53190, 53211, and 53236.

53063 (AD-672225) COMPARISON OF DISCRETE ORDINATES CALCULATIONS WITH MEASURED NEUTRON SPECTRA IN STANDARD SHIELD GEOMETRIES. Profio, A. E. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 8, 1968. Contracts AF29(601)-6720; DA-49-146-XZ-482. 11p. CFSTI.

The anisotropic discrete ordinates code GAPLSN, its down-scattering-only version GGSN, and the newer 1DF version of the DTF-IV code were used to analyze most of the spatially-dependent neutron spectrum experiments at the General Atomic Linear Accelerator. The neutron spectrum was measured by the pulsed-source, time-of-flight method with an accuracy of about ±10% and an energy resolution of 2% or better below 1 MeV, rising to 8% at 15 MeV. (auth) (USGRDR)

53064 (AERE-R-5832) SCATTERING LAW $S(\alpha,\beta)$ VALUES FOR A MIXTURE OF LIGHT WATER AND HEAVY WATER. Page, D. I. (Atomic Energy Research Establishment, Harwell (England)). July 1968. 33p. Dep. CFSTI. UK 5s. 0d.

The differential scattering cross sections for a mixture of equal parts of light water and heavy water at 300°K were measured for neutrons of 0.101- and 0.056-eV incident energy. The results are given as tables of scattering law $S(\alpha,\beta)$-values derived directly from the experimental data. The values cover ranges of energy and momentum transfers of 0 to 0.13 eV and 1 to 17 $Å^{-1}$, respectively. (auth)

53065 (ANL-7426) SNARG-2D: A TWO-DIMENSIONAL, DISCRETE-ORDINATE, TRANSPORT-THEORY PROGRAM FOR THE CDC-3600. Duffy, G. J.; Greenspan, H.; Sparck, S. D.; Zapatka, J. V.; Butler, M. K. (Argonne National Lab., Ill.). Mar. 1968. Contract W-31-109-eng-38. 61p. Dep. CFSTI.

The computer program SNARG-2D for the solution of the two-dimensional neutron transport equation is described; and a simple problem is given. The program is written in FORTRAN IV for the CDC-3600. (J.W.R.)

53066 (KFK-770) GROUP CONSTANTS FOR STEAM-AND SODIUM-COOLED FAST REACTORS IN A 26-GROUP REPRESENTATION. Huschke, H. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Apr. 1968. 131p. (In German). (EUR-3953). Dep.

The group constants for the energy-dependent P_1 equations of multigroup theory are defined. The cases of elastic and inelastic scattering and no scattering are considered. Position dependence of the group constants and calculational procedures for determining group constants are outlined; expressions for energy self-shielding factors for resonance parameters are given. Equations for cross-section calculations are developed. Elastic scattering matrix equations are formulated. Nuclear parameters are tabulated for hydrogen, carbon, oxygen, sodium, aluminum, chromium, iron, nickel, uranium-235, uranium-238, and plutonium-239. 15 references. (M.L.S.)

53067 NEUTRON SCATTERING FROM MgO. Borgonovi, G. M.; Carriveau, G. W. (Gulf General Atomic Inc., San Diego, Calif.). Phys. Rev., 174: 953-8(Oct. 15, 1968).

The single differential angular scattering cross section of neutrons from a single crystal of magnesium oxide was measured and was calculated using a lattice-dynamical model. A shell model with interactions to second neighbors was used to calculate the frequencies, polarization vectors, and gradients of the frequencies. Scattering experiments were made using a pulsed source of neutrons obtained with a linear electron accelerator. To compare the measured angular distributions with the theory, the one-phonon coherent cross section was computed using a formula given by Waller and Fröman. Measurements and computations of the single differential cross sections are presented at four different orientations of the single crystal for scattering processes in a main symmetry plane. (auth)

53068 ON THE DETERMINATION OF THE THERMALIZATION POWER M_2 IN MIRAMID PLASTIC. Albert, D.; Blumentritt, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 11: 132-3(May 1968). (In German).

A method for the determination of the thermalization power M_2 for moderators was previously proposed. The method was characterized as a stationary method requiring only very small amounts of the moderator material and quite low experimental expenditure, since the moderator is mixed homogeneously with 1/v absorber and the saturation activity of irradiated non-1/v samples is measured. The method was tested on Miramid using a pulsed neutron source. The results are tabulated and graphed. A value of $M_2 = 1.37 \pm 0.72\ cm^{-1}$ was obtained, in good agreement with the M_2 value determined by the stationary method. (J.S.R.)

53069 THERMAL NEUTRON TRANSMISSION FOR THIN 1/v ABSORBERS. Fritzsch, E. (Physikalischen Institut der Bergakademie, Freiberg i. B.). Kernenergie, 11: 134-5(May 1968). (In German).

The equation for the transmission of thermal neutrons in a thin 1/v absorber is given. It is applied to any thick 1/v absorber and to the special case $A(\Sigma_{r,o}d) = 1$. The differences between the values calculated by the exact formula and the approximation are tabulated. (J.S.R.)

53070 INVESTIGATION OF THE ALIGNMENT OF THE FAST NEUTRON CURRENT FROM COLLIMATORS. Fominykh, V. I.; Yudin, M. F.; Yanovskii, A. P. Izmer. Tekh., No. 7, 52-5(July 1968). (In Russian).

It was established that the effective center of the complex source (source + collimator) is displaced from the geometric center of the source forward to the orifice. The contribution of the neutrons scattered by the collimator to the direct current was determined. The coefficient K, characterizing this contribution, can be considered constant and equal to 1.37 with an error of ±5% for the investigated interval between detector and neutron source (Po–Be, Pu–Be). The results obtained were used during calibration of neutron devices in collimated beams. (tr-auth)

53071 ON CERTAIN FREDHOLM INTEGRAL EQUATIONS REDUCIBLE TO INITIAL VALUE PROBLEMS. Wing, G. M. SIAM (Soc. Ind. Appl. Math.) Rev., 9, 655-70(Oct. 1967).

Solid mathematical grounds of special procedures applied in such branches of science as radiative transfer and transport theory are stated. Physical approach to such questions by Ambarzumian has been put on a more analytical level by Chandrasekhar, and the method is now known as invariant imbedding. It finds its abundant applications also in many advanced problems outside the field of transport theory. Classical results are extended to larger classes of integral equations without presuming any physical knowledge of transport phenomena. In this way, the subject becomes accessible to pure mathematicians, which will certainly contribute to further development and improvement of the theory. A partial integrodifferential equation of the Boltzmann type with appropriate boundary conditions is associated with a Fredholm integral equation whose kernel is expressed in terms of a Laplace integral. Applying the method of invariant imbedding to the original "transport-like" problem leads to valuable results concerning the associated Fredholm equation. This procedure can be extended to multidimensional cases. (App. Mech. Rev.)

53072 NEUTRON THERMALIZATION IN BENZENE. Sprevak, D.; Borgonovi, G. M.; Neill, J. M.; Carriveau, G. W. (Gulf General Atomic Inc., San Diego, Calif.). Contract AT(04-3)-167. Nukleonik, 11: 233-40(Sept. 1968). (GA-8185).

A model describing the molecular dynamics of benzene was formulated. This model was used to compute thermal neutron scattering data which were compared to values reported in the literature. Measurements of the neutron total and angular scattering cross section of benzene were made. The theoretical values from this new model were compared to these measurements. This model is being used to generate data for submission to the Evaluated Nuclear Data File. (auth)

53073 HINDERED-ROTATIONS EFFECT ON NEUTRON THERMALIZATION IN LIGHT WATER. Ardente, V.; Gallus, G. (EURATOM, Ispra, Italy). Nukleonik, 11: 251-4(Sept. 1968).

A modified Nelkin model for slow neutron scattering by light water is proposed, which takes into account in a simplified way the structure of hindered rotations. In calculating differential cross sections, the incoming neutron energy range is divided into three regions, where the various dynamical modes are treated in different approximations. Theoretical previsions are compared with experiment for total scattering cross section, average scattering cosine, average diffusion coefficient $\langle D\nu \rangle$, and mean second energy-transfer moment M_2. Influence on infinite medium spectrum is also investigated in the case of heavy 1/v poisoning. Significant improvements in the agreement with experiments are shown, as compared to results of the original Nelkin model, for various integral quantities of interest in neutron thermalization. (auth)

53074 NEUTRON SCATTERING AMPLITUDE OF POTASSIUM. Bacon, G. E.; Plant, J. S. (Sheffield Univ., Eng.). Z. Kristallogr., 126: 460-1(Aug. 1968).

The neutron-scattering amplitude of potassium was measured to be $0.369 \pm .003 \times 10^{-12}$ cm. (J.W.R.)

53075 OPTIMIZATION OF RESULTS OBTAINED FROM INTEGRALS OVER POISSON DISTRIBUTED DATA. I. OPTIMAL CORRELATION FUNCTIONS FROM ELASTIC NEUTRON SCATTERING DATA IN SIMPLE LIQUIDS. Schlup, Werner A. (IBM Zurich Research Lab.). Phys. Chem. Liquids, 1: 73-91 (Feb. 1968).

It is shown how the counting time at different scattering angles in particle scattering experiments has to be chosen so that a physical quantity given by an integral over Poisson-distributed data may be optimally determined; i.e., with the smallest possible uncertainties. The method was applied to the elastic scattering of thermal neutrons by liquid Ar. The optimal angle or time distribution of the measurements for obtaining the total and direct particle correlation functions was calculated from the known data. The result may be used as a starting point for improved measurements. (BBB)

53076 SLOW NEUTRON INELASTIC SCATTERING BY TRANSITION METAL HYDRIDES. Pan, Sung Sun. Troy, N. Y., Rensselaer Polytechnic Inst., 1967. 271p.

Thesis.

Measurements of inelastic neutron scattering by the metal hydrides ZrH_x, TiH_2, TlH_2, and NbH were made by the filter difference method and phased chopper method within the incident neutron energy range of 0.1 to 0.7 eV. An electron linear accelerator provided an intense pulsed neutron source of large area, enabling measurements to be made at significantly higher energies than is possible with a reactor. The resolution was ±4 to 8% for neutron energy changes of 0.1 to 0.5 eV comparable to that of existing phased chopper apparatus in this energy range. Measurements include the vibrational energies, level spacings and level widths for each hydride at room temperature. The phased chopper apparatus was the RPI-KAPL inelastic scattering system. In this technique, the linac pulsed source is triggered by a signal from a large aperture high speed neutron chopper; the phase between the two determines the neutron velocity selected by the chopper. Neutrons scattered from the sample were detected by banks of 10 atm ^{3}He proportional counters arrayed at six scattering angles; the energy spectrum of scattered neutrons was deduced from the time of flight record. Cross sections were obtained relative to a vanadium standard. These measurements include low-temperature measurements on ZrH_2 and NbH as well as angular dependence of scattering in various samples at room temperature. Scattered neutrons were detected at angles of 25, 40, 60, 90, 120, and 150° with respect to the incident neutron beam. Results for ZrH_x are as follows: With higher incident energies, multiple excitation of the bound level at 0.137 eV was observed. The dependence of the level widths on neutron scattering angle and on specimen temperature was obtained. Variations of the widths of the inelastic peaks were found when hydrogen concentrations were changed over the range $0.15 \leq x \leq 2.0$. Very little difference in either the width or the shape of the levels was observed between 295° and 77°K. The variations of the level widths as a function of momentum transfer for ZrH_2 were compared with calculations based on the harmonic approximation. Comparison of the double differential cross section measurements with calculations based on an "Einstein" oscillator and the combination of an oscillator with an acoustical spectrum did not provide unique results. The measured angular distribution for the 0.137 eV level at low temperature showed less angular dependence than that predicted by the harmonic oscillator model. The elastic scattering also deviated from the harmonic oscillator model for high momentum transfers. Calculations based on the independent Einstein oscillator model were compared with the experimental cross sections and large disagreement was found. The vibration spectrum represented by the Debye spectrum for acoustic modes and a delta function for optical mode was also poor. Improvement in the model with respect to these points can best be made by using the measured frequency distribution to perform theoretical calculations. The NbH data exhibits excitations extending from 0.1 to 0.18 eV with two prominent maxima at 0.12 and 0.164 eV. These are believed to correspond to the 1–0 transition in the optical band split into longitudinal and transverse modes. This multipeaked spectrum also leads to the conclusion that the proton sits in the octahedral hole of the niobium lattice. (Diss. Abstr.)

53077 THE OPERATIONAL B_L^N TECHNIQUE AS APPLIED TO PULSE PROPAGATION IN FAST NON-MODERATING ASSEMBLIES. Denning, Richard Smith. Gainesville, Fla., Univ. of Florida, 1967. 138p.

Thesis.

The B_L technique is extended to the investigation of finite systems by operational manipulation. In the methodology of the B_L technique, the inverse of the loss-terms of the Boltzmann operator must be determined. In infinite systems where the spatial derivatives can be removed by a Fourier transformation, the loss-terms of the Boltzmann operator become merely a multiplicative scalar. The inverse is the reciprocal of the scalar. Finite cases can not be handled so simply. In the operational B_L^N technique, the inverse operator is represented by an infinite Neumann Series. In general the Nth-order approximation is obtained by truncating the series at the Nth term. The motivation of the technique was the need to obtain theoretical values of eigenvalues measured in two types of experiments. Die-away experiments have been performed at the Massachusetts Institute of Technology on non-moderating metal assemblies with monoenergetic neutrons in the few MeV range with the intent of measuring removal and scattering cross sections. Because of the advantages found with neutron-wave experiments in the measurement of thermal parameters, fast neutron-wave experiments are planned at the University of Florida to be performed on assemblies very similar to those used in the fast die-away experiments. Because these assemblies are so small when measured in mean free paths, the usual approximate solutions to the Boltzmann equation have not been found sufficient. The B_L^N technique is applied to both types of experiments in the approximation of linearly anisotropic scattering (L = 1). In each case it was possible to extend the order of the approximation N to ∞ by inverting the summations which result from the expansion of the inverse operator. In the neutron-wave experiment the dispersion law for the modulus of the wave vector, K, is derived and is shown to be an intensive property of the material. The transverse eigenvalues k_x and k_y are obtained from "no return current" boundary conditions at the sides of the assembly. These eigenvalues are found to be complex quantities implying that there is wave propagation toward the sides of the assembly as well as down the length of the assembly. The axial eigenvalue, K_3, which is the quantity measured in the experiment can be calculated from the relation $K_3^2 = k_x^2 + k_y^2 + K^2$. The treatment of the die-away experiment follows the analysis of the neutron-wave experiment very closely, and the two experiments are shown to be related by the same generalized dispersion law. Relations are obtained from which the decay constant, λ, and buckling (curvature) of the flux can be calculated for parallelepiped assemblies. In both cases, methods of calculating cross sections from experimental data are shown using the B_1^3 model. The B_1^3 dispersion law for the neutron-wave experiment is compared with P_N calculations. For large N P_N appears to approach the B_1^3 model. In the die-away experiment, the decay constant obtained from B_1^3 theory agreed with the P_N calculations for large assemblies and with SP_2 for moderately small assemblies as expected. Experimental data was also available for comparison. Agreement with the B_1^3 model was found to be well within experimental error. (Diss. Abstr.)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 51460, 53095, and 53099.

53078 (UCRL-18268) TABLES OF STRUCTURE AMPLITUDES FOR (p,t) REACTIONS. Glendenning, Norman K. (California Univ., Berkeley. Lawrence Radiation Lab.). June 1968. Contract W-7405-eng-48. 43p. Dep. CFSTI.

Tables of structure amplitudes for (p,t) reactions on A = 4 through 224 nuclei are presented. (J.W.R.)

53079 TWO-PROTON FINAL-STATE INTERACTIONS IN THE REACTIONS ^{3}He(d,t)2p, D(^{3}He,t)2p, ^{3}He(^{3}He,^{4}He)2p, AND H(^{3}He,d)2p. Morton, Bobby Joe. Knoxville, Tenn., Univ. of Tennessee, 1967. 87p.

Thesis.

The energy spectra of the observed particles for the reactions ^{3}He(d,t)2p, d(^{3}He,t)2p, ^{3}He(^{3}He,^{4}He)2p, and p(^{3}He,d)2p were measured at forward angles using the 36-MeV deuteron beam and the 53- and 74-MeV ^{3}He beams from the Oak Ridge Isochronous Cyclotron. Each of the spectra were characterized by a peak in the high-energy region corresponding to the two unobserved protons having a low relative energy. These peaks were attributed to the enhancement of the cross section in this energy region by the final-state interaction of the two protons. The data were analyzed using the final-state interaction theory of Watson and Migdal. This theory gave an adequate representation of the data for the reactions ^{3}He(d,t)2p and ^{3}He(^{3}He,^{4}He)2p using the known proton-proton interaction. However, for the other reactions, d(^{3}He,t)2p and p(^{3}He,

d)2p the observed peaks were much narrower than the theoretical predictions. For the reaction d(^{3}He,t)2p, the narrower peak could be explained by assuming the primary reaction mechanism is a charge exchange process and calculating this effect using the impulse approximation. (Disser. Abstr.)

53080 STILL ANOTHER UNSUCCESSFUL SEARCH FOR ^{5}H. Booth, N. E.; Beretvas, A.; Davis, R. E. P.; Dolnick, C.; Hill, R. E.; Raymond, M.; Sherden, D. (Univ. of Chicago). Nucl. Phys., A119: 233-7(1968).

A search for ^{5}H was carried out using the reaction ^{7}Li(π^-,pn)^{5}H. No evidence for the reported ^{5}H activity was found, although the activities ^{8}Li and ^{9}Li from a natural boron target and ^{12}B from a carbon target were easily observed. (auth)

53081 PARITY NONCONSERVATION AND THE REACTION $n + d \rightarrow \gamma + H_3$. Moskalev, A. N. (Ioffe Physico-Technical Inst., Leningrad). JETP Lett. (USSR) (Engl. Transl.), 8: 27-8(July 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 46-9(July 5, 1968).

The results of calculations of P-odd correlations in thermal neutron capture by deuterium are presented. The correlations are the result of weak interactions between the nucleons in the neutron-deuteron system and in tritium. Comparison with similar results for neutron capture by protons shows that the accuracy of measurements on neutron capture by deuterium must be improved by at least one order of magnitude to permit the observation of effects of parity nonconservation. (J.W.R.)

53082 POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM DEUTERONS AT 12.0 MeV. Clegg, T. B.; Plattner, G. R.; Haeberli, W. (Univ. of Wisconsin, Madison). Nucl. Phys., A119: 238-40(1968).

A 12-MeV polarized proton beam from the Wisconsin tandem accelerator was scattered from a gaseous deuterium target. Left-right asymmetries of the elastically scattered protons and recoil deuterons were measured to obtain an angular distribution of the proton polarization between $15° \leq \Theta_{cm} \leq 160°$. The present measurements agree with earlier results from this laboratory, but do not show the dip to negative values near $\Theta_{cm} = 30°$, which has been reported by McKee et al. (auth)

53083 ELASTIC SCATTERING OF 14-MeV NEUTRONS BY DEUTERONS. Berick, A. C.; Riddle, R. A. J.; York, C. M. (Univ. of California, Los Angeles). Phys. Rev., 174: 1105-11 (Oct. 20, 1968).

The differential cross section for the elastic scattering of neutrons by deuterons was measured at a neutron energy of 14.3 ± 0.2 MeV. The data cover the center-of-mass scattering angles from 13.5 to 158.6°, and the cross section at each angle was measured with a statistical accuracy from 2 to 3%. The scattering sample was a deuterated benzene scintillator coupled to a photomultiplier tube. The time of flight of the scattered neutron was measured by utilizing the recoil-deuteron pulse in the scattering-sample counter to start the timer, and a pulse produced by the scattered neutron in a plastic scintillation counter to stop it. Background events were limited by placing pulse-height restrictions on the pulses from the scattering-sample counter. The data were normalized to the experimentally determined n-p scattering cross section at 14.1 MeV. The relative efficiency of the scattered-neutron detector at each energy was determined by performing the experiment with a nondeuterated benzene scintillator in place of the deuterated target. The angles chosen for the n-p scattering were those for which the neutron energies were the same as those for the scattering angles chosen for the n-d experiment. The known values of the n-p scattering cross section were then used to evaluate the n-d cross section. The angular distribution shows a deeper minimum near 120° and higher values in the forward directions than is indicated by previous experimental results. An eighth-order polynomial is required to fit the angular distribution, and the value of the total cross section is in good agreement with earlier values. (auth)

53084 NEW EXCITED LEVEL IN ^{4}He. Fick, D.; Franz, H. W. (Univ., Erlangen-Nuernberg, Ger.). Phys. Lett., 27B: 541-3(Sept. 30, 1968).

With the D(d,p)^{3}H and the D(d,n)^{3}He reactions, a new 1^-, T = 0 level was found in ^{4}He at 23.9 MeV. It is seen via an initial state interaction in the above reactions. (auth)

53085 NUCLEON-NUCLEUS FORWARD DISPERSION RELATIONS. Ericson, T. E. O.; Locher, M. P. (CERN, Geneva). Phys. Lett., 27B: 576-7(Sept. 30, 1968).

Forward dispersion relations are illustrated by n-α elastic scattering. The evaluation of low energies shows the great importance of exchange effects, This result should be valid in general for light nuclei. (auth)

53086 TOTAL CROSS-SECTIONS FOR n–p AND n–d SCATTERING AT 10 GeV/c NEUTRON MOMENTUM. Engler, J. (Institut fuer Experimentelle Kernphysik, Karlsruhe, Ger.); Horn, K.; Koenig, J.; Moennig, F.; Schludecker, P.; Schopper, H.; Sievers, P.; Ullrich, H.; Runge, K. Phys. Lett., 27B: 599-601(Sept. 30, 1968).

The total neutron cross sections were measured with high precision for hydrogen and deuterium. At an average neutron momentum of 10 GeV/c, σ_T(np) = 39.5 ± 0.5 mb and σ_T(nd) = 73.3 ± 1.1 mb. These values are in excellent agreement with p-p and p-d total cross sections. No energy dependence was found for n-p cross section between 4 and 10 GeV/c. (auth)

53087 PROTON–PROTON ELASTIC SCATTERING BETWEEN 6 AND 10 MeV. Slobodrian, R. J.; Conzett, H. E.; Shield, E.; Tivol, W. F. (Univ. of California, Berkeley). Phys. Rev., 174: 1122-9(Oct. 20, 1968).

Proton-proton elastic scattering angular distributions were measured at 6.141-, 8.097-, and 9.918-MeV laboratory energy, in an experiment designed to achieve an absolute accuracy better than 1%. Phase-shift analyses were performed using S, split P, and D waves. The P-wave splitting was assumed to be dominated by a central-plus-tensor interaction or a central-plus-spin-orbit interaction. In both cases, the P-wave splitting was kept small, a condition imposed by the small polarizations measured in this energy range. (auth)

53088 HIGH-ENERGY PROTON SCATTERING AND THE STRUCTURE OF LIGHT NUCLEI. Bassel, Robert H.; Wilkin, Colin (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1179-99(Oct. 20, 1968).

The elastic and total cross sections of 1-BeV protons on ^{2}H, ^{4}He, ^{12}C, and ^{16}O are analyzed, in conjunction with the corresponding electron scattering measurements, on the basis of Glauber's high-energy approximation. This leads to information which cannot be obtained from the electron data alone. (auth)

53089 PARITY CONSERVATION IN THE REACTION T(d,n)^{4}He. Bonar, D. C.; Drake, C. W.; Headrick, R. D.; Hughes, V. W. (Yale Univ., New Haven). Contract AT(30-1)-2726. Phys. Rev., 174: 1200-7(Oct. 20, 1968). (YALE-2726-508).

An experimental test for parity conservation in the strong nuclear reaction T(d,n)^{4}He was made using an incident accelerated beam of polarized deuterons. The deuterons, incident with 140-keV energy on a thick target of titiated titanium, were vector-polarized transverse to the beam direction. The experiment measured the ratio in numbers of neutrons emitted parallel and antiparallel to the direction of the initial polarization vector, using opposed neutron counters. Periodic reversal of the polarization vector was used to eliminate instrumental asymmetries. The magnitude of the real part of the relative parity-violating amplitude, $|\mathrm{Re}\mathcal{F}|$, was found to be $\lesssim 3.8 \times 10^{-3}$, consistent with the conservation of parity. (auth)

53090 EXISTENCE OF THE TRINEUTRON. Jacob, Horace; Gupta, V. K. (Univ. of Delhi). Phys. Rev., 174: 1213-20(Oct. 20, 1968).

The possibility of the existence of a trineutron bound state was investigated by using a separable N-N interaction in the p wave. Two different sets of central and spin-orbit forces of the $(L \cdot S)$ and $(L \cdot S)^2$ types were used to obtain a detailed fit to the ^3P_j scattering phase shifts. The calculations were performed for the $J^p = \frac{1}{2}^+$ state, which was shown by Mitra and Bhasin to be the best possible candidate for such a bound state. The solution of the coupled one-dimensional integral equations, as an eigenvalue problem in the "inverse strength parameter" of the n-n interaction, shows that the requisite eigenvalue for zero binding energy for the n^3 system has a sufficiently wide margin over the corresponding quantity obtained from the p-p phase shifts. This confirms the earlier conclusion of Mitra and Bhasin based on effective central p-wave forces, but is contradictory to the results of variational approaches with conventional potentials given by Okamoto and Davies, and by Barbi. The possible significance of the difference is discussed. (auth)

53091 TRITIUM RADIATION. pp 4-6 of Tritium-Labeled Molecules in Biology and Medicine. Feinendegen, Ludwig E. New York and London, Academic Press, 1967.

The radioactive decay of the tritium nucleus involves the emission of an electron (β particle) and a neutrino, in which process one of the neutrons changes into a proton. The result is a stable helium ion with a nuclear mass of 3. Thus the decay scheme of tritium is a simple one-step process, i.e., $^3\mathrm{H} \rightarrow {}^3\mathrm{He} + \beta^-$. The continuous spectrum of the β^- emission varies from a maximum of 18.6 KeV down, with an average energy of 5.6 KeV. The excitation energy of the resultant helium ion (produced by the change

in charge) adds to the damage resulting from tritium decay in biological material. (E.R.B.)

53092 A MEASUREMENT OF THE NEUTRON–PROTON DIFFERENTIAL CROSS SECTION AND POLARIZATION AT 200 MeV: BOTH FREE n-p AND n-p IN DEUTERIUM. Thomas, Alan Richard. New York, Univ. of Rochester, 1968. 124p.

Thesis.

The free neutron–proton differential cross section and polarization at 199 MeV was measured in the angular range 77 to 160°CM. In addition, the cross section and polarization in the (n-d) reaction n + d → p + (n + n) with the proton detected was measured. A neutron beam was prepared by charge exchange scattering the 85% polarized proton beam of the University of Rochester synchrocyclotron from deuterium. The beam had an energy spread of ±11.8 MeV, a polarization of 70%, but an intensity of only 1000 neutrons/sec. The neutrons were incident on a hydrogen or deuterium target. Recoil protons were detected by scintillation counters. The cross section, measured to 2 to 3%, agrees well with measurement of Kazarinov and with the predictions of the phase shift solutions $(Y\text{-}IV)_{np}$ and A-M. The deuterium rates are 60 to 70% of the hydrogen rates and 10 to 20% smaller than the calculated rates using an impulse approximation with final-state interactions. The neutron–proton polarization measured to 0.010 to 0.025 agrees with the YLAN 3 and 3M, $(Y\text{-}IV)_{np}$ and A-M predictions but not with the measurement of Tinlot between 75 and 120°CM. Agreement between the n-p and n-d polarizations is good at 127 to 160°CM and is acceptable at other angles. (Diss. Abstr.)

53093 CROSS SECTION MEASUREMENTS OF PION DOUBLE CHARGE EXCHANGE ON VANADIUM AT 31 MeV AND LITHIUM AT 30 MeV. Cook, Charles James. New York, Univ. of Rochester, 1968. 79p.

Thesis.

The differential cross section for the pion double charge exchange reaction on $^{51}V(\pi^+,\pi^-)$ at 31 MeV, production angle of 29°, and pion energy loss from 7 to 19 MeV, has been measured to be $.52^{+.71}_{-.19}$ μb/sr. Two events were observed. It is predicted that the pion would lose 13.3 MeV if the nucleus were left in its isobaric analogue state with $\Delta T_z = 2$. Thus this measurement is at least an upper limit on the cross section to the analog state. A similar measurement on $^7Li(\pi^+,\pi^-)$ at 30 MeV and pion energy loss of 7 to 17 MeV gave a cross section of $.165^{+.225}_{-.060}$ μb/sr. Again, two events were observed. Positive pions were produced within the Rochester 130 inch Cyclotron. Particle trajectories were recorded with foil spark chambers. The charge and momenta of outgoing particles were determined with a truncated wedge magnet which contained a spark chamber in the center of its gap. Range of these particles was measured and compatibility of range and momentum was required for a good event. The detection system was tested with a negative pion beam. (Diss. Abstr.)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 53078, 53080, 53088, 53223, 53235, and 53247.

53094 (ANL-Trans-656) ANGULAR DISTRIBUTIONS OF THE RECOIL NUCLEI FROM THE REACTION $^{19}F(p,pn)^{18}F$. Denisov, F. P.; Milovanov, V. P.; Pokrovskii, V. N.; Cherenkov, P. A.; Yutlandov, I. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Yadern. Fiz., 7: 743-4(1968). 4p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 35244. (auth)

53095 (BMwF-FBK-68-11) STUDIES OF NUCLEAR STRUCTURE ON THE DARMSTADT 60 MeV ELECTRON LINEAR ACCELERATOR. (Technische Hochschule, Darmstadt (West Germany). Institut fuer Technische Kernphysik). Apr. 1968. 143p. (In German). Dep.

The results of research performed with the accelerator, the operating experience thus obtained, and the improvements made to the accelerator and experimental equipment are summarized. Using elastic electron scattering, nuclear radii were measured with high precision, whereas high-resolution inelastic electron scattering was used to investigate excited levels in light nuclei. In addition, nuclear photoeffect experiments were carried out with bremsstrahlung, and accelerator-produced radioactive nuclides were used for β- and α-decay studies as well as Moessbauer experiments. (auth)

53096 (CEA-R-3314) CONTRIBUTION TO THE EXPERIMENTAL STUDY OF THE REACTIONS $^9Be(^3He,3\alpha)$ AND $^{10}B(d,3\alpha)$. Thouvenin, Pierre (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Mar. 1968. 111p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

For studying these reactions, the detection of the final particles emitted in coincidence in the directions θ_1 and θ_2, together with the biparametric analysis of the corresponding pulses were used. This method enables one to obtain the orthogonal Dalitz diagrams (E_1, E_2). An examination of the spectra obtained shows that the sequential mechanism appears to predominate. The contribution of the purely statistical process was less than 15 per cent of the total spectrum. In the case of $^{10}B(d,3\alpha)$, for E_d = 1.5, 2.66, and 3 MeV, the width of the peak of the first particles emitted, with respect to ^8Be excitations close to 11 MeV, was found to be equal to 2.6 ± 0.6 MeV, much less than the width of the second excited state observed by $\alpha-\alpha$ scattering. The coincidence spectra and the free spectra give an excitation energy of E_x = 2.68 ± 0.07 MeV for the first excited state of ^8Be. Some remarks are made concerning the anomalies observed for E_d = 5 MeV and 9 MeV. The excited levels of ^8Be at 13.91 MeV and 7.56 MeV, which have been described in the past, were not observed. (auth)

53097 (CEA-R-3504) STUDY OF THE REACTIONS $^9Be(d,\alpha_0)^7Li$, $^9Be(d,\alpha_1)^7Li^*$, $^9Be(d,t)^8Be$, AND $^9Be(d,p_0)^{10}Be$ FROM 300 TO 1000 keV. Bertrand, Francoise; Grenier, Gerard; Pornet, Jacqueline (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). May 1968. 26p. (In French). Dep.

Angular distributions, excitation functions, and total cross sections are presented for the reactions $^9Be(d,\alpha)^7Li$, $^9Be(d,p)^{10}Be$, and $^9Be(d,t)^8Be$. The data are in good agreement with previously reported results. (D.C.W.)

53098 A COMPARATIVE STUDY OF (p,t) AND (p,^{3}He) REACTIONS ON LIGHT NUCLEI. Fleming, Donald George. Berkeley, Calif., Univ. of California, 1967. 155p.

Thesis.

The (p,t) and (p,^{3}He) reactions on ^{15}N and ^{13}C targets were investigated. Transitions to mirror final states in the mass 13 and mass 11 final nuclei were studied over 15 and 12.5 MeV of excitation, respectively. Several new spin and parity assignments are made. In particular, the lowest 1p shell T = ½ states in these nuclei were identified. The DWBA predictions of the angular distributions arising from these (p,t) and (p,^{3}He) transitions were generally found to well reproduce experiment. For the $^{15}N(p,t)^{13}N$ and $^{15}N(p,^3He)^{13}C$ reactions, these calculations were carried out using intermediate coupling wave functions to describe the final state; for the $^{13}C(p,t)^{11}C$ and $^{13}C(p,^3He)^{11}B$ reactions, pure jj configurations were assumed. In addition to giving a good account of the observed angular distributions, the DWBA calculations of relative cross sections for the (p,t) transitions were also found to be in good agreement with experiment. Comparative measurements of these (p,t) and (p,^{3}He) reactions populating mirror final states was used to test some of the assumptions made in current theories of direct two-neucleon transfer reactions. The agreement in cross-section ratios of mirror (p,t) to (p,^{3}He) transitions is found to improve in every case with the inclusion of a strongly spin-dependent force in the nucleon-nucleon interaction, but overall satisfactory agreement is not obtained. The (p,t) transitions are found to be generally stronger than expected relative to their mirror (p,^{3}He) transitions, and three cases are discussed where the experimental ratios of these cross sections exceed the theoretical upper limit. Interference terms arising either through the spin-orbit interaction in the optical potential or through a core-excitation mechanism are suggested as accounting for this result. (Disser. Abstr.)

53099 PRODUCTION OF THE RADIOISOTOPES ^{11}C, ^{13}N, AND ^{15}O USING THE DEUTERON BEAM FROM A 3-MeV VAN DE GRAAFF ACCELERATOR. Ritchie, A. I. M. (AAEC Research Establishment, Lucas Heights, New South Wales). Nucl. Instrum. Methods, 64: 181-4(Sept. 15, 1968).

A technique is described for the production of the radioisotopes ^{11}C, ^{13}N and ^{15}O in gaseous form using the deuteron beam from a 3-MeV Van de Graaff. Activities of about 20 mCi/l, 80 mCi/l and 50 μCi/l, respectively, of the isotopes were produced at gas flow rates of about 0.1 l/min. The apparatus could be modified to produce higher yields, in particular, higher yields of ^{15}O. An accurate measurement of the half-life of ^{13}N was made and yielded a value of (9.963 ± 0.009) min in good agreement with earlier measurements. (auth)

53100 COMPARISON OF THE (d,^{3}He) AND (d,t) REACTIONS ON SOME N = Z NUCLEI. Gaillard, M.; Bouche, R.; Feuvrais,

L.; Gaillard, P.; Guichard, A.; Gusakow, M.; Leonhardt, J. L.; Pizzi, J.-R. (Univ., Lyon). Nucl. Phys., A119: 161-83(1968). (In French).

Differential cross sections were measured for the ground-state groups of the (d,^{3}He) and (d,t) reactions on some light N = Z nuclei and for elastic scattering of 28-MeV deuterons by the same targets. The (d,^{3}He) and (d,t) cross sections are equal for ^{10}B, ^{12}C, and ^{14}N targets and different but "parallel" for ^{16}O, ^{28}Si, ^{32}S and ^{40}Ca targets. The yield of ^{3}He is larger than the yield of tritons. The DWBA predicted ratios of (d,^{3}He) and (d,t) cross sections are compared with the experimental values. The influence of various terms in the DWBA calculations is studied. The Coulomb interaction is responsible for the large difference in the wave functions describing the bound states of the proton and the neutron which are to be captured. These wave functions are shown to have a predominant influence on the absolute values of the computed cross sections. (auth)

53101 THE ENERGY LEVELS OF ^{14}O AND ^{18}Ne FROM (^{3}He,n) REACTIONS. Towle, J. H.; Wall, G. J. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Nucl. Phys., A118: 500-14(1968).

A neutron time-of-flight spectrometer was used to measure angular distributions and excitation functions for the reactions ^{12}C(^{3}He,n)^{14}O and ^{16}O(^{3}He,n)^{18}Ne at ^{3}He energies between 9 and 10.6 MeV. The results indicate a direct reaction mechanism, and good agreement is obtained with angular distributions from DWBA double stripping calculations. These comparisons indicate the following energy-level spins and parities: ^{14}O ground state 0^+, 5.15 MeV 1^- or 0^+, 5.91 MeV $0^+(1^-)$ and 6.30 MeV (3^-); ^{18}Ne ground state 0^+, 1.88 MeV 2^+, 3.36 MeV(4^+) and 3.61 MeV 2^+. A new level was observed in ^{18}Ne at 4.59 ± 0.03 MeV. The level schemes are compared with those of the mirror nuclei ^{14}C and ^{18}O. (auth)

53102 ELECTROMAGNETIC TRANSITIONS IN ^{11}Be AND ^{14}C. Bell, R. A. I.; Gill, R. D.; Robertson, B. C.; Lopes, J. S.; Rose, H. J. (Nuclear Physics Lab., Oxford). Nucl. Phys., A118: 481-99(1968).

The ^{12}C(t,α) and ^{12}C(t,p) reactions were used in conjunction with standard particle-gamma correlation techniques to study excited states of ^{11}B and ^{14}C. The following spins, branching ratios, and electromagnetic multipole mixing ratios were determined: for the 5.02-Mev ^{11}B level, J = 3/2, transition (5.02 → ground state): (88.0 ± 2.5)%, δ(E2/M1) = 0.03 ± 0.05 and transition (5.02 → 2.12): (12.0 ± 2.5)%, δ(E2/M1) = −0.05 ± 0.20; for the 4.44-MeV ^{11}B level, transition (4.44 → ground state): δ(E2/M1) = −0.19 ± 0.03; for the 6.72-MeV ^{14}C level, J = 3, transition (6.72 → 6.09): (2.7 ± 1.0)%; for the 7.01 MeV ^{14}C level, J = 2, transition (7.01 → 6.09): (1.4 ± 0.7)%; for the 7.35-MeV ^{14}C level, J = 2, transition (7.35 → ground state): (14 ± 4)%, transition (7.35 → 6.09): (52 ± 5)%, δ(M2/E1) = −0.04 ± 0.09 and transition (7.35 → 6.72) : (34 ± 4)%, δ(M2/E1) = 0.07 ± 0.30. The results are compared with model predictions. (auth)

53103 ANGULAR DISTRIBUTION OF THE p_1 PROTON GROUP AND p_1−γ ANGULAR CORRELATIONS IN THE REACTION ^{11}B(d,p)^{12}B. Gorodetzky, S.; Beck, F. A.; Bertini, R.; Knipper, A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys., A118: 556-62(1968). (In French).

Angular distribution of p_1 protons feeding the first excited state of ^{12}B and p_1−γ angular correlations were measured in the ^{11}B(d,p)^{12}B reaction at a bombarding energy of 700 keV. These results can be made to agree with a simple Butler theory, but a comparison with the previously measured angular distribution of the 955-keV γ rays shows that the plane-wave description is inadequate. (auth)

53104 ANGULAR DISTRIBUTION AND PLANE POLARIZATION OF 955-keV γ RAYS FROM ^{12}B. Gorodetzky, S.; Beck, F. A.; Bertini, R.; Chevallier, J.; Knipper, A. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Phys., A118: 545-55(1968). (In French).

The "distribution-polarization" method for gamma rays is described and applied to ^{12}B. This method allows electromagnetic transitions from an oriented level to be studied without detailed knowledge of the orientation mechanism (e.g., nuclear reaction). The asymmetry of the 955-keV gamma rays from the ^{11}B(d,p)^{12}B reaction is a rapidly decreasing function of the bombarding energy. At E_d = 700 keV, the angular distribution has $A_2 = -0.113 \pm 0.017$, and the plane polarization is p = +0.102 ± 0.029. This agrees with $J = 1^+$ or 2^+ for the excited state in ^{12}B; for $J = 2^+$ (in better agreement with other evidence), the mixing ratio is $\delta = -0.08 \pm 0.06$ for the M1 + E2 admixture. (auth)

53105 NUCLEAR-SPECTROSCOPIC INVESTIGATION ON ^{8}Li, ^{42}K, ^{88}Rb, ^{141}Ce, ^{144}Ce, ^{144}Pr, AND ^{203}Hg. Daniel, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Collin, W.; Kuntze, M.; Margulies, S.; Martin, B.; Mehling, O.; Schmidlin, P.; Schmitt, H. Nucl. Phys., A118: 689-97(1968). (In German).

The half-life of ^{8}Li was found to be $T_{1/2}$ = 0.854 ± 0.008 sec. The $2^- \rightarrow 2^+$ β-groups of ^{42}K and ^{88}Rb were measured with the Heidelberg intermediate-image spectrometer. The shape factors show large deviations from the statistical shape with large statistical errors, however, in the case of ^{88}Rb. The integral β-circularly polarized γ-correlations were measured by Compton forward scattering. For ^{42}K, rather uncertain best values for the six matrix elements were obtained. The β-circularly polarized γ-correlation of ^{141}Ce is characterized by an asymmetry parameter $\bar{\omega} = -0.16 \pm 0.05$, which favours a value of X in the range $4.5 < X < 6.5$, where X is the matrix element ratio in the ξ-approximation. In the cases of ^{144}Ce and ^{203}Hg, the reduced anisotropy coefficient ϵ' of the β-γ directional correlation was found to be positive and not strongly energy dependent (^{144}Ce), and negative and strongly energy dependent (^{203}Hg). The β-circularly polarized γ-correlations of ^{144}Ce, ^{144}Pr and ^{203}Hg were measured. The ^{144}Ce correlation has $\bar{\omega}$ = 0.64 ± 0.25. The ^{144}Pr results (two cascades) agree with the formerly established value of 0^- for the ^{144}Pr ground state. The ^{203}Hg result $\bar{\omega} = -0.18 \pm 0.04$ confirms the negative sign of the β-transversely polarized conversion electron correlation. The results are discussed with respect to the ξ-approximation. (auth)

53106 SUM RULES FOR E1 TRANSITIONS IN ^{16}O AND ^{15}N. Yano, Fleur B. (California State Coll., Los Angeles). Nucl. Phys., A118: 592-608(1968).

Electric dipole transition rates from even-parity states of ^{15}N to ground state are calculated in a nuclear shell model. The terms of greatest dipole strength are in the giant resonance region and correspond to pure $1p_{\frac{1}{2}} \rightarrow 1d_{\frac{3}{2}}$ excitations. Also, total cross sections for ^{15}N(γ,p_0)^{14}C and ^{15}N(γ,n_0)^{14}N are calculated and are compared with experiment. Construction of dipole states of ^{15}N and ^{16}O in the n-p formalism permits the identification of specific terms in the residual interaction which account for the energy and width of dipole states. Finally, sum rules for E1 and single-particle amplitudes are discussed. (auth)

53107 LOW-LYING 0^+ STATES IN A THREE-ALPHA MODEL OF ^{12}C. Hebach, Hans; Henneberg, Peter (Max-Planck-Institut fuer Chemie, Mainz). Z. Phys., 216: 204-12(1968).

The nucleus ^{12}C is treated as a system composed of three alpha particles. Separable potentials are used for the s-wave and d-wave interactions between two alpha particles. Applying Faddeev's theory, two 0^+-states are found in the neighborhood of the three-particle threshold. (auth)

53108 STUDY OF ^{19}F BY USE OF (^{3}He,p) AND (α,d) REACTIONS. Mangelson, Nolan F. (Univ. of Washington, Seattle); Harvey, Bernard G.; Glendenning, Norman K. Nucl. Phys., A119: 79-96(1968).

Spectra and angular distributions were obtained for the reactions and conditions ^{16}O(^{3}He,p)^{18}F at E(^{3}He) = 19.8 MeV from θ_{lab} = 9° to 170° for ^{18}F excited states below 11.3 MeV excitation and for ^{16}O(α,d)^{18}F at E(α) = 40.3 MeV from θ_{lab} = 8° to 80° for ^{18}F excited states below 12.7 MeV excitation. Distorted-wave (DW) calculations for the (^{3}He,p) reaction were compared to experimental angular distributions and relative total cross sections. Agreement was found when a spin-independent interaction potential was used. Nuclear wave functions used in the calculations are discussed. Spectroscopic and configuration assignments were made or confirmed on the basis of excitation energy, angular distributions, comparison of (α,d) and (^{3}He,p) results, relative total cross sections, and comparison of experimental quantities to DW calculations. Configurations and J^π values of 3^+ and 4^+ were suggested for ^{19}F levels at 3.358- and 5.594-MeV excitation energy, respectively. Configurations and $J^\pi T$ values were confirmed for some levels, and T = 0 assignments were made for a large number of levels. A new ^{19}F level at an excitation energy of 8.596 ± 0.019 MeV was identified. (auth)

53109 THREE-BODY REACTIONS RESULTING FROM ^{8}Li + d. Legg, J. C.; Simpson, W. D.; Emerson, S. T. (Rice Univ., Houston, Tex.). Nucl. Phys., A119: 209-20(1968).

Three-body reactions resulting from ^{8}Li + d at a deuteron bombarding energy of 10 MeV were studied by the coincident detection of two charged-particle reaction products in silicon surface barrier detectors. Mass identification of one of the particles was accomplished using a time-of-flight technique. Final-state interactions are observed through states in the possible intermediate nuclei. Decay through excited states of ^{6}He near 20.2 and 21.9 MeV was observed but with branching ratios significantly different from those previously reported. Interference effects were observed in the d-d and α-d coincident spectra. (auth)

53110 TENSOR POLARIZATION OF DEUTERONS FROM THE ^{9}Be(p,d)^{8}Be REACTION FOR E_p = 1.6 TO 3.8 MeV. Froelich,

A. J.; Darden, S. E. (Univ. of Notre Dame, Ind.). Nucl. Phys., A119: 97-112(1968).

The tensor polarization of the deuterons from the $^{9}Be(p,d)^{8}Be$ reaction was measured for proton energies in the range 1.6-3.8 MeV and for lab emission angles between 10° and 90°. The tensor polarization was measured by observing the deviation from isotropy of the proton angular distribution of the $^{3}He(d,p)^{4}He$ reaction, when the deuterons from the $^{9}Be(p,d)^{8}Be$ reaction were incident on a ^{3}He gas cell with energies below 600 keV. The largest magnitude of polarization observed occurred at $E_p = 2.0$ MeV, $\theta_{lab} = 10°$, where t_{20} was found to be 0.53 ± 0.08. For proton bombarding energies below 2.6 MeV, a pronounced energy dependence of the polarization is present, while in the energy range 2.7 to 3.8 MeV less variation was observed. Neither a DWBA calculation using spin-orbit potentials nor a plane-wave calculation including deuteron D-state effects has been successful in reproducing the magnitude and angular variation of the tensor polarization data, although the differential cross-section data above $E_p = 2.5$ MeV strongly suggest that the (p,d) "pick-up" reaction is the predominant reaction mechanism at these bombarding energies. (auth)

53111 NEUTRON CROSS-SECTION MEASUREMENTS OF ^{12}C BETWEEN 14 AND 25 MeV. Boreli, F.; Kinsey, B. B.; Shrivastava, P. N. (Univ. of Texas, Austin). Phys. Rev., 174: 1147-54(Oct. 20, 1968).

Measurements of the elastic and nonelastic cross sections for neutrons on ^{12}C were made over the energy range between 14 and 25 MeV using a spherical shell of scattering material surrounding a stilbene detector. In addition to the known peak in the elastic scattering at 19.5-MeV neutron energy, another was found at 15.8 MeV. The widths of these peaks at half-maximum are 2.0 and 0.5 MeV, respectively. No resonance structure in the nonelastic scattering cross section was found. With specially designed scatterers, the differential elastic scattering was measured at angles which correspond to the zeros of the first four Legendre polynomials, viz., at 90, 54.8, 39.2, and 30.5°. The excitation function of elastic scattering at these angles showed a similar resonance structure in each case, the weakest being at 90°. Inelastic neutron scattering to the first excited state of ^{12}C was determined between 14 and 21 MeV by measuring the 4.43-MeV γ rays produced by the decay of this state. A very small peak was found at 15.8 MeV and a broader rise near 19 MeV. The low level of resonant effects in the nonelastic channels suggests that the resonances observed in the elastic cross section are caused by single-particle states, and the differential measurements indicate that they are caused by p waves. (auth)

53112 STUDY OF THE TWO-BODY FORCE THROUGH THE (^{3}He,t) CHARGE-EXCHANGE REACTION ON ^{17}O AND ^{18}O. Hansen, Luisa F. (Univ. of California, Livermore); Stelts, Marion L.; Vidal, Jose G.; Wesolowski, J. J.; Madsen, V. A. Phys. Rev., 174: 1155-65(Oct. 20, 1968).

A study of the (^{3}He,t) reaction on ^{17}O and ^{18}O was made at 17.3 MeV, using gas targets of enriched isotopes. The elastic ^{3}He differential cross sections were also measured, and an optical-model analysis was performed. The triton angular distributions show the predominance of a direct reaction mechanism. They were analyzed using a distorted-wave Born-approximation formalism assuming a two-body interaction V_{0i} between the incident and target nucleons; i.e., $V_{0i} = \tau_0 \cdot \tau_i (V_{\sigma\tau} \sigma_0 \cdot \sigma_i + V_\tau) f(\mu_{0i})$. The strengths of the spin-isospin interaction $V_{\sigma\tau}$ and the pure isospin interaction V_τ were found to be 34.7 ± 6 and 52.0 ± 10 MeV, respectively. The form factors $f(\mu_{0i})$ for both interactions were taken to have a Yukawa shape with a range of 1 F. For the (^{3}He,t) transitions to the analog state, a further analysis was made using an exact coupled-channel-equation calculation. (auth)

53113 SINGLE-PROTON EMISSION FOLLOWING POSITIVE PION ABSORPTION IN CARBON. Witten, T. R.; Blecher, M.; Gotow, K. (Virginia Polytechnic Inst., Blacksburg). Phys. Rev., 174: 1166-8(Oct. 20, 1968).

Pions are usually absorbed by a pair of nucleons in complex nuclei. It is, however, possible for the pion to be absorbed by a single nucleon, leading to the emission of only one nucleon. Letourneux and Eisenberg have pointed out that this latter reaction would be useful in studying single-neutron states within nuclei and as a test of the validity of perturbation theory for low-energy pion-nucleus interactions. Accordingly, a search was made for the reaction $^{12}C(\pi^+,p)^{11}C$ at 68-MeV pion energy and 11° proton emission angle. The observed cross section of 640 ± 130 μb/sr for absorption by $1p_{\frac{3}{2}}$ neutrons is more than eight times larger than the theoretical value. (auth)

53114 THEORETICAL CALCULATIONS OF STATISTICAL HEAVY-ION REACTIONS. Gadioli, E.; Iori, I.; Zetta, L. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Phys. Rev., 174: 1140-6(Oct. 20, 1968).

The following three groups of reactions involving heavy ions are analyzed: $^{12}C(^{12}C,\alpha)^{20}Ne$; $^{12}C(^{16}O,\alpha)^{24}Mg$; and $^{12}C(^{6}Li,p)^{17}O$. These reactions have been carefully studied: their excitation functions show strong fluctuations which can be interpreted as due to purely statistical processes. The energy interval over which the excitation functions extend are sufficiently large to include several fluctuations and to permit a meaningful comparison between theory and experiment. It is shown that the theoretical expression given by the statistical model for the average compound-nucleus (CN) integrated and differential cross sections in terms of the average resonance parameters reproduce the experimental data very well if $\Gamma_j/D^{J\pi} \gg 1$, also when $\langle\Gamma_{\lambda c}^{J\pi}\rangle/D^{J\pi}$ and, correspondingly, the transmission coefficients are not much less than unity. Two relations were used to connect the average resonance parameters to optical-model transmission coefficients. The first is obtained by equalizing the absorption cross section to the CN formation cross section, and leads to the widely used Hauser-Feshbach expression; the second is obtained by equalizing the optical-model transition matrix to the energy average of the reaction-theory transition matrix. Though it appears a little more appropriate to use the first relation, definite conclusions cannot be drawn on this point, because of the uncertainty affecting the experimental values of the cross sections and the average optical-model and level-density parameters. (auth)

53115 ANALYSIS OF THE $^{12}C(p,\alpha)^{9}B$ REACTION AT 44.5 MeV. Li, T. Y.; Hird, B. (Univ. of Manitoba, Winnipeg). Phys. Rev., 174: 1130-3(Oct. 20, 1968).

A distorted-wave Born-approximation theory is described which uses a combination of square-well and harmonic-oscillator potentials in the local energy approximation to take account of the finite-range effects in (p,α) direct pickup reactions. A fit was obtained to the forward part of the $^{12}C(p,\alpha)^{9}B$ angular distribution which gives agreement with the calculated spectroscopic factor. In contrast, no reasonable set of parameters was found which could fit the experimentally observed peak at backward angles, providing some supporting evidence that it is probably caused by an exchange process. (auth)

53116 DETERMINATION OF THE NEUTRON POLARIZATION FROM THE $^{13}C(^{3}He,n)^{15}O_{g.s.}$ REACTION FROM 2.9 to 3.9 MeV. Stammbach, Th.; Thomason, R. S.; Taylor, J. Jr.; Walter, R. L. (Duke Univ., Durham, N. C.). Phys. Rev., 174: 1119-21(Oct. 20, 1968).

Angular distributions of the polarization of neutrons produced in the $^{13}C(^{3}He,n)^{15}O_{g.s.}$ reaction were obtained at 2.95, 3.45, and 3.85 MeV. The polarization at 20° lab at six additional energies between 3.0 and 3.9 MeV was measured also. Scattering from ^{4}He contained at a high pressure in a scintillation cell served as the neutron polarization analyzer. The three angular distributions were somewhat similar in shape, in that they showed large negative minima around 40° and 120° lab and zero or positive polarization around 80° lab. Preliminary attempts to describe the polarization using an l = 0 diproton-stripping-reaction approach were unsuccessful, but this is attributed to inadequate knowledge of the optical-model parameters. (auth)

53117 PION DOUBLE-CHARGE-EXCHANGE CROSS-SECTION MEASUREMENTS. Cook, C. J.; Nordberg, M. E. Jr.; Burman, R. L. (Univ. of Rochester, N. Y.). Phys. Rev., 174: 1374-9 (Oct. 20, 1968).

The differential cross section for the pion double-charge-exchange reaction $V^{51}(\pi^+,\pi^-)$, at an incident energy of 31 MeV and a production angle of 29°, was measured to be 0.52 μb/sr. The apparatus was sensitive to a pion-energy difference of 7 to 19 MeV, which covers the predicted isobaric analog state of $\Delta T_z = 2$. A similar measurement for $^{7}Li(\pi^+,\pi^-)$ gave a differential cross section of 0.165 μb/sr. Particle trajectories were photographed in thin-foil spark chambers. The charge and momenta of outgoing particles were determined with a magnet, and their range was determined in a thick-plate spark spark chamber. (auth)

53118 DOUBLE CHARGE EXCHANGE OF POSITIVE π MESONS ON COMPLEX NUCLEI. Boynton, P. E. (Princeton Univ., N. J.); Devlin, Thomas J.; Solomon, J.; Perez-Mendez, V. Contract AT(30-1)-2137. Phys. Rev., 174: 1083-92(Oct. 20, 1968).

The differential cross section for the reaction $\pi^+ + N(z,n) \rightarrow \pi^- + X$ was measured at lab angles of 8.5° and 16°, with incident 200-MeV π^+ mesons. Several target nuclei were employed: ^{51}V, ^{90}Zr, and ^{7}Li. The momentum analysis of the final-state π^- was accomplished with a magnetic spectrometer, using digitized wire spark chambers for track location. Recent theoretical papers indicate the possibility of exciting isobaric analog states [for which X = N(z + 2, n − 2): a two-body final state]. The data show no evidence of this state, and provide an upper limit of 1 to 2 μb/sr on its excitation at both 8.5 and 16°. The contribution to the cross section from all final states is 40 to 60 μb/sr for the various targets and angles and for $110 \geq T_{\pi^-} \geq 200$ MeV. The data are dis-

cussed in terms of a pion-complex-nucleus interaction model, including effects of higher-order inelastic scattering. (auth)

53119 $^{16}O(\alpha,2\alpha)^{12}C_{g.s.}$ REACTION MECHANISMS NEAR 25 MeV. Parker, A. W.; Allen, J. S.; Yerke, R. L.; Stotland, V. G. (Univ. of Illinois, Urbana). Phys. Rev., 174: 1093-1104 (Oct. 20, 1968).

Measurements of the angular correlation between the two α particles emitted in the reaction $^{16}O(\alpha,2\alpha)^{12}C_{g.s.}$ at incident energies near 25 MeV suggest that this reaction can be described in terms of both sequential and one-step knockout processes. The sequential reaction proceeds as inelastic α-particle scattering followed by α-particle decay of the excited levels of ^{16}O to levels of ^{12}C. Only the transitions to the ground state of ^{12}C were studied. The most strongly excited levels were those at 11.1 and 13.88 MeV. The strong energy dependence of the cross section for the reaction going through the 13.88-MeV level indicates the existence of a broad state in ^{20}Ne with an excitation energy near 24 MeV. Apparently, resonance effects are present in the initial-state interaction at this excitation. Any quasielastic scattering appears as a background under the peaks of the sequential reaction. The angular distribution of this background is in limited agreement with the predictions of a modified Born-approximation model which takes into account the final-state interaction between the two α particles. (auth)

53120 DIRECT HIGH-ENERGY PHOTOPROTONS FROM ^{12}C. Manuzio, G. (Univ., Genoa); Ricco, G.; Sanzone, M.; Ferrero, L. Phys. Rev. Lett., 21: 1266-8(Oct. 21, 1968).

The energy spectra of fast photoprotons from ^{12}C were measured for a bremsstrahlung energy between 50 and 80 MeV. The analysis of the obtained cross section shows a strong direct emission from the 1p shell. (auth)

53121 ELECTRON EXCITATION OF PARTICLE-HOLE STATES IN ^{12}C. Donnelly, T. W.; Walecka, J. D.; Sick, I.; Hughes, E. B. (Stanford Univ., Calif.). Contracts F44620-68-C-0075; 225(67). Phys. Rev. Lett., 21: 1196-1200(Oct. 14, 1968).

Theoretical and experimental results are presented for electron excitation of particle–hole states in ^{12}C. (auth)

53122 EFFECT OF THE LIFETIME OF THE INTERMEDIATE ^5Li STATE IN THE $^6Li(^3He,\alpha p)^4He$ REACTION. Reimann, M. A.; Martin, P. W.; Vogt, E. W. (Univ. of British Columbia, Vancouver). Can. J. Phys., 46: 2241-52(Oct. 15, 1968).

A cylindrical asymmetry about the direction of motion of ^5Li was seen in the breakup of the ground state of this nucleus observed as an intermediate state in the reaction $^6Li(^3He,p\alpha)^4He$. Measurements were made at bombarding energies of 1.00, 1.25, and 1.50 MeV with isotopically enriched LiF targets using a two-dimensional analysis technique. Both the rough magnitude of the asymmetry and its qualitative energy dependence are explained in terms of a simple semiclassical model. In this model the origin of the asymmetry is associated with the short life of the ^5Li intermediate state and with the memory retained by the proton during this short life of its "localization" at the time of formation of ^5Li. (auth) (CANADA)

53123 PRODUCTION OF SOME SHORT-LIVED ACTIVITIES WITH 14-MeV NEUTRONS AND DETERMINATION OF THE ACTIVATION CROSS SECTION. Flesch, F.; Hille, P. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 176: No. 3, 45-55(1967). (In German).

By irradiation of NaCl and B_4C samples with neutrons at 14.7 ± 0.1 MeV, the reactions $^{23}Na(n,\alpha)^{20}F$, $^{23}Na(n,p)^{23}Ne$, and $^{11}B(n,p)^{11}Be$ were induced. The effective cross sections of these reactions were determined to be 141 mb ± 15%, 44 mb ± 21%, and 5.1 mb ± 18%, respectively. The values of 10.81 ± 0.11 sec and 13.60 ± 0.42 sec were measured for the half-lives of ^{20}F and ^{11}Be, respectively. (tr-auth)

53124 ^{10}C AND MASS MEASUREMENTS FOR LIGHT NUCLEI. Brunnader, H.; Hardy, J. C.; Cerny, Joseph (Univ. of California, Berkeley). Phys. Rev., 174: 1247-9(Oct. 20, 1968).

The mass excess of ^{10}C and the excitation energy of its first excited state were measured using the $^{10}B(^3He,t)^{10}C$ reaction. The results confirm one of three earlier measurements which gave the mass excess as 15.7025 ± 0.0018 MeV, and an average of all relevant measurements for the energy of the first excited state yields 3.344 ± 0.008 MeV. These values differ significantly from those previously accepted, and since they provided energy calibrations for measurements on a number of light nuclei, appropriately revised results are quoted for the mass excess of ^{37}Ca, as well as for the energies of the second excited state in ^8B and $T = \frac{3}{2}$ states in ^7Be, ^{21}Na, and ^{37}K. (auth)

53125 PROTON AND NEUTRON RESONANCES IN NITROGEN. Borelli, F.; Shrivastava, P. N.; Kinsey, B. B.; Mistry, V. D. (Univ. of Texas, Austin). Phys. Rev., 174: 1221-7(Oct. 20, 1968).

Angular distributions and integrated cross sections were measured for protons scattered elastically and inelastically from nitrogen. A broad peak, about 1 MeV wide, centered near 9 MeV, was found in the elastic cross section without a corresponding rise in the cross section in any of the inelastic channels. The angular distribution suggests that this peak is a p-wave scattering. Broad peaks in inelastic channels (about 0.5 MeV wide) were observed near 10 MeV for protons leading to the second excited state of ^{14}N, and at 10.7 and 11.3 MeV for protons producing the fourth and sixth excited states. None of these peaks has a counterpart in the elastic scattering. They are probably caused by the production of intermediate states. Corresponding to the 9-MeV elastic proton resonance, a broad resonance (0.4 MeV wide) was found in the elastic scattering of neutrons from nitrogen at 5.3 MeV. This resonance has a peak cross section of 0.5 b, which requires that the ratio of the neutron width to the total width be near unity. The nonelastic cross section does not show a resonance at this energy. (auth)

53126 SPIN–ISOSPIN DEPENDENT INTERACTION FROM INELASTIC PROTON SCATTERING ON ^6Li. Austin, S. M.; Crawley, G. M. (Michigan State Univ., East Lansing). Phys. Lett., 27B: 570-2(Sept. 30, 1968).

The differential cross section for the inelastic scattering of protons leading to the ($J^\pi = 0^+$, $T = 1$) state of ^6Li at 3.56 MeV was measured at $E_p = 24.4$ MeV. A real spin-isospin dependent interaction with a Yukawa shape, a strength of 12.7 MeV and a range of 1.0 fm fits the data well at small angles. (auth)

53127 DOUBLE SCATTERING OF 51-MeV DEUTERONS ON CARBON. Seibt, E.; Weddigen, Ch.; Weigele, K. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Phys. Lett., 27B: 567-9(Sept. 30, 1968).

Double-scattering of 51-MeV deuterons on carbon shows strong vector polarization effects. Tensor polarization effects are found to be small. Optical model predictions by Satchler could be confirmed qualitatively. Quantitatively, there are significant discrepancies. (auth)

53128 MUON-CAPTURE AND PHOTON-ABSORPTION CALCULATIONS IN A CONFIGURATION-MIXING MODEL FOR ^{16}O. Walker, G. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 174: 1290-1303(Oct. 20, 1968). (LA-DC-9517).

The utility of multiparticle, multihole configuration mixing as a mechanism for resolving certain theoretical-experimental discrepancies for muon capture and photodisintegration on ^{16}O is considered. An ^{16}O ground state containing a two-particle, two-hole (2p-2h) component is assumed. The usual particle-hole odd-parity states are amended to contain three-particle, three-hole configuration admixtures consistent with the choice of the more complicated ground state. The results of the calculations indicate that the configuration-mixing model can appreciably lower the partial muon-capture rates to the lowest 0^-, 1^-, and 2^- states. Moreover, a shift in the energy distribution of the transition strength, obtained in the model calculations, lowers the capture rate and photodisintegration cross section in and below the giant-resonance region. However, correction terms, arising mainly from $0^+ \rightarrow 1^+$ (2p-2h) allowed Gamow–Teller transitions, seem to preclude a lowering of the total capture rate. (auth)

53129 MASS AND SPECTROSCOPIC MEASUREMENTS OF COMPLETE ISOSPIN QUARTETS IN THE LIGHT NUCLEI. Butler, Gilbert Wayne. Berkeley, Calif., Univ. of California, 1967. 90p.

Thesis.

The mass 13, 21, and 37 isospin $T = \frac{3}{2}$ quartets have been completed through a series of nuclear reaction investigations. A standard particle identifier was used to measure the mass of the $T_z = -\frac{3}{2}$ nuclide ^{13}O via the $^{16}O(^3He,^6He)^{13}O$ reaction at 65 MeV. An improved particle-identification system, which employed two transmission (dE/dx) and one stopping (E) detector, was used to determine the masses of the $T_z = -\frac{3}{2}$ nuclei ^{21}Mg and ^{37}Ca via the $^{24}Mg(^3He,^6He)^{21}Mg$ and $^{40}Ca(^3He,^6He)^{37}Ca$ reactions at 56 MeV. The first three $T = \frac{3}{2}$ levels in ^{21}Ne were established by a simultaneous study of the $^{22}Ne(d,t)^{21}Ne$ and $^{22}Ne(d,^3He)^{21}F$ reactions at 39.6 MeV, while the $^{23}Na(p,t)^{21}Na$ reaction at 42 MeV was utilized to observe the lowest $T = \frac{3}{2}$ level in ^{21}Na. Excitation energies of the lowest $T = \frac{3}{2}$ levels in ^{37}K and ^{37}Ar were determined via the $^{39}K(p,t)^{37}K$ and $^{39}K(p,^3He)^{37}Ar$ reactions induced by 45-MeV protons. Data from the complete isospin quartets were used to test the isobaric multiplet mass equation and the various predictions of masses of neutron-deficient nuclei. Preliminary studies of the angular distributions of the $^{16}O(^3He,^6He)^{13}O$, $^{16}O(^3He,^6Li)^{13}N$, $^{16}O(^3He,^7Li)^{12}N$, and $^{16}O(^3He,^7Be)^{12}C$ reactions at 70 MeV are also presented. (Diss. Abstr.)

53130 DIFFRACTION INTERACTION OF LIGHT NUCLEI WITH NUCLEI. Ismatov, E. (Inst. of Nuclear Physics, Tash-

kent). Dokl. Akad. Nauk Uzb. SSR, No. 1, 28-31(1968). (In Russian).

Previous studies on the interaction of light nuclei with nuclei revealed that the experimental findings agree with theoretical prediction, i.e., the relative motion of clusters follow a Gaussian function. In connection with this problem, the dependence of the integral elastic scattering and diffraction spallation cross sections, the total interaction cross section, and the angular distribution of elastically scattered nuclei and spallation products were further studied, considering the selected wave function of the relative motion of the clusters. It was found that in the case of ^{2}H, ^{6}Li, ^{9}Be, and ^{13}C nuclei, the total diffraction spallation cross section exceeds the theoretically derived values by not more than 15%. Study of the angular distribution of deuterons formed by the spallation of 63-MeV ^{6}Li nuclei on ^{12}C nuclei confirmed the theoretical conclusions concerning the diffraction interaction of light nuclei, as indicated by the parameter p which is a function of the radius of interaction and the mean-square radius of the clustered nucleus. (TTT)

53131 CENTRE OF MASS MOTION IN THE EXCITED STATES OF THE FINAL NUCLEUS IN REACTIONS SUCH AS $(\pi^+,2p)$ REACTIONS ON LIGHT NUCLEI. TRANSITION PROBABILITIES FOR THE REACTION ^{6}Li$(\pi^+,2p)^{4}$He. Baus-Baghdikian, M.; Fuld-Rouserez, M. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg. (5), 54: 294-314(1968).

The spurious part in the harmonic oscillator wave functions due to the center-of-mass motion can be extracted in simple cases by a method based on the normal coordinates (Smith and Brennan). The cross section for the $(\pi^+,2p)$ reaction on light nuclei, and in particular on ^{6}Li, is given taking into account the spurious part due to the center-of-mass motion in the final excited states. The transition operator is simply $\delta(\vec{r}_\pi - \vec{r}_i)\vec{\sigma}_i \cdot \vec{\nabla}_i$, and the basic nuclear wave functions are eigenfunctions of the independent particle Hamiltonian with a harmonic oscillator potential without spin–orbit coupling. (auth)

53132 ANGULAR CORRELATIONS IN UNIQUE MUON CAPTURE BY SPIN TARGETS. Oziewicz, Z.; Pikulski, A. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., 34: 291-9(Aug. 1968).

The angular correlations in the process of muon capture by nonzero spin targets followed by gamma emission are considered in the case of unique allowed and forbidden transitions. The formulas for some exceptional interesting correlation constants are given. The experimental study of these correlations may serve as a very sensitive way to determine the magnitude of the induced pseudoscalar term. (auth)

53133 POLARIZATION OF 40-MeV ^{3}He IONS ELASTICALLY SCATTERED FROM ^{12}C. Hutson, Richard Lee. Boulder, Colo., Univ. of Colorado, 1967. 128p.

Thesis.

Elastic scattering cross sections for 36- and 42-MeV ^{3}He ions scattered from ^{12}C were measured and a double-scattering asymmetry measurement was performed in which ^{3}He ions were scattered from ^{12}C. The average energy was 41 and 36 MeV at the two targets. On the basis of an optical model analysis of the data, it was concluded that a spin–orbit strength of 6 MeV, approximately equal to the spin–orbit strength for nucleons, is inconsistent with the measurements for ^{3}He scattering. A maximum probable value of about 3.5 MeV, based on the measured asymmetry plus one standard deviation, was estimated for the case of ^{3}He scattering from ^{12}C around 40 MeV. The results of the measurements and analysis were consistent with theoretical calculations of 1.67 MeV for the spin–orbit potential carried out by T. F. Smith and P. D. Kunz at the University of Colorado. (Diss. Abstr.)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 52959, 53074, 53078, 53093, 53095, 53100, 53105, 53117, 53118, 53123, 53129, 53165, 53166, 53227, 53235, 53247, and 53249.

53134 (COO-1120-70) COLLECTIVE EFFECTS IN THE ^{31}P(^{3}He,p)^{33}S REACTION. Cox, R. S.; West, R. W.; Ascuitto, R. J. (Kansas Univ., Lawrence. Nuclear Physics Lab.). Aug. 1967. Contract AT(11-1)-1120. 27p. (CONF-670821-2). Dep. CFSTI.

From Meeting of the American Physical Society, Seattle, Wash.

Angular distributions for the reaction ^{31}P(^{3}He,p)^{33}S were measured at an incident ^{3}He energy of 6 MeV. Angular distributions for the elastic scattering of ^{3}He ions were also measured in order to define the optical-model parameters. The reaction data were analyzed in terms of the two-nucleon stripping theory, and the results were interpreted in terms of the strong-coupling collective model. (D.C.W.)

53135 COLLECTIVE PROPERTIES OF N = 50 ISOTONES. Gillet, V.; Giraud, B.; Picard, J.; Rho, M. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett., 27B: 483-6(Sept. 16, 1968).

Vibrational properties in the N = 50 isotones are calculated within the Tamm-Dancoff approximation and random phase approximation framework including neutron particle-hole excitations of the closed N = 50 shell and using a phenomenological treatment practically free of adjustable parameters. Core-coupling is essential for the octupole vibration, but this simple picture fails for the properties of even-parity states. (auth)

53136 ^{46}Ti(p,p′γ)^{46}Ti ANGULAR CORRELATION MEASUREMENTS. Horoshko, R. N.; Hinrichsen, P. F.; Scott, H. L. (Franklin Inst., Swarthmore, Pa.). Nucl. Phys., A118: 609-27 (1968).

Angular correlation measurements in the 180° geometry for the ^{46}Ti(p,p′γ) reaction were used to determine spins and the γ branching ratios for states at 2.962, 3.059, 3.168, and 3.236 MeV excitation. Gamma spectra observed with a Ge(Li) spectrometer were used to obtain accurate excitation energies and served as an independent check on the branching ratios. Using the available information, these states were assigned spins and parities $J^\pi = 2_1^+$, 3_1^-, 1_1^+, and 2_3^+, respectively. The 2.96-, 3.17-, and 3.24-MeV states were found to decay to the ground and 2_1^+ states with ground-state branchings of 4.3 ± 0.8%, 44 ± 3%, and 20 ± 2%, respectively. The corresponding (L + 1)/L mixing ratios for transitions to the 2_1^+ state give δ = −1.15, −0.4, and 0.0 ± 0.1, respectively. The sign convention is that of Litherland and Ferguson. The 3_1^- state was found to have a 90 ± 3% branch (δ = 0.0 ± 0.1) to the 4_1^+ state, a possible branch of ≤3% to the 2_1^+ state, and indirect evidence was found for an unusual 10 ± 3% branch to the 2_2^+ state. The reduced E1 transition rates for the 3_1^- state show a highly preferred decay to the 2_2^+ state, which is in a qualitative agreement with the calculations of Soga. (auth)

53137 STUDY OF THE REGION OF 3-MeV EXCITATION IN ^{27}Al. Gallmann, A.; Jundt, F.; Aslandes, E.; Bromley, D. A. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Phys., A118: 515-28(1968). (In French).

The region of the 3-MeV doublet of ^{27}Al was subjected to precision investigation via broad-range magnetic analysis, gamma-ray spectroscopy, and gamma-gamma coincidence measurements. The excitation function for the ^{27}Al(p,p′)^{27}Al reaction was measured for E_p = 4.32-4.43, 4.81-4.90, and 5.70-5.80 MeV. No evidence was found for a third level at 3-MeV excitation in ^{27}Al, which had been suggested by the discrepancies in reported measurements in this excitation region. The present results support the assignment $^{9}/_{2}^+$ to the 3.002-MeV state; branching ratio data are in accord with earlier measurements. It is not possible to reproduce all the static and dynamic properties of the low levels of ^{27}Al with either strong- or weak-coupling models, although features of both are present; this is consistent with the assumption that ^{27}Al lies in a transition region between regions of positive and negative static deformation. (auth)

53138 DECAY OF 78.4-hr ^{89}Zr. Hinrichsen, P. F. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., A118: 538-44 (1968).

Sources of 78.4-hr ^{89}Zr were produced by the ^{89}Y(p,n)^{89}Zr reaction, and the decay properties were studied with Ge(Li) detectors. The energies of previously reported γ-ray transitions were measured to be E_γ = 909.1 ± 0.1, 1620.6 ± 0.7 and 1713.0 ± 0.6 keV. Two new transitions of E_γ = 1656.9 ± 0.7 and 1744.4 ± 0.7 keV were also observed, the latter being assigned as a ground-state transition from the $^{5}/_{2}^-$ state. The absence of any observed cascade feeding of this state leads to log ft = 8.3 for this unique first-forbidden transition. (auth)

53139 FINE STRUCTURE OF ANALOGUE RESONANCES IN THE ^{44}Ca(p,p) AND ^{50}Ti(p,p) REACTIONS. Gaarde, C.; Kemp, K.; Nielsen, T. (Univ., Copenhagen). Nucl. Phys., A118: 641-9 (1968).

Fine structure of analogue resonances was studied by elastic proton scattering on ^{44}Ca and ^{50}Ti. The analogue state corresponding to the 1.90-MeV excited state in ^{45}Ca was observed at bombarding energies around 1.65 MeV with its strength distributed over six resonances. The energy resolution was about 600 eV. The analogue state corresponding to the first excited state (E_{ex} = 1.16 MeV) in ^{51}Ti is distributed over at least eight components, which appear in the excitation function around 2.55 MeV. The data were analyzed in terms of a one-channel multilevel formula. On the basis of a particular model, the average cross section is calculated. It is shown that in the gross structure, the compound elastic scattering must be taken into account.

Analogue widths are deduced, and spectroscopic factors are calculated by two methods. (auth)

53140 NEUTRON TOTAL CROSS SECTIONS IN THE ENERGY RANGE 100 TO 150 MeV. Schneider, R. J.; Cormack, A. M. (Tufts Univ., Medford, Mass.). Nucl. Phys., A119: 197-208 (1968).

Neutron total cross sections were measured with an uncertainty of 1% or less for Al, Cu, Cd, Pb, and U at energies from 100 to 150 MeV, with an energy resolution of 1 MeV. The cross sections and published non-elastic cross sections were analyzed in terms of the optical model. The real and imaginary parts of the central potential were determined at each energy. It was found that no single set of radial parameters was optimum for all energies. Both the cross sections and the potentials fit smoothly to other data at lower energies. (auth)

53141 LEVEL-CROSSING-INVESTIGATION OF THE HYPERFINE STRUCTURE OF THE EXCITED $3^2P_{\frac{1}{2}}$ AND $4^2P_{\frac{1}{2}}$ STATES OF ^{23}Na. Schoenberner, D.; Zimmermann, D. (Technische Univ., Berlin). Z. Phys., 216: 172-82(1968). (In German).

The hyperfine structure of the excited $3^2P_{\frac{1}{2}}$- and $4^2P_{\frac{1}{2}}$-state of ^{23}Na was investigated in a level-crossing-experiment by means of a detailed analysis of the dependence of the scattered resonance light as a function of the magnetic field. From the experimental curves, the hyperfine structure constants A and B and the lifetimes τ were deduced. The nuclear electric quadrupolemoment of ^{23}Na derived from these values is $Q = 0.097 \times 10^{-24}$ cm^2, where the Sternheimer-correction has been applied. (auth)

53142 THE ^{20}Ne(d,n)^{21}Na REACTION. Burbank, M. B.; Frank, G. G.; Davison, N. E.; Neilson, G. C.; Wong, S. S. M.; McDonald, W. J. (Univ. of Alberta, Edmonton, Can.). Nucl. Phys., A119: 184-96(1968).

The structure of ^{21}Na was investigated using the ^{20}Ne(d,n)^{21}Na reaction at E_d = 3.92, 5.16, and 6.08 MeV. Differential cross sections were obtained for neutron groups corresponding to the four bound states of ^{21}Na. The data are compared with DWBA and Hauser-Feshbach predictions for direct and compound reaction cross sections. Absolute spectroscopic factors are deduced for the ^{21}Na bound states and are compared with predictions of the Nilsson and shell model descriptions for this nucleus. (auth)

53143 DETECTION OF THE NONCONSERVATION OF TIME SYMMETRY BY MEANS OF THE MOESSBAUER EFFECT. Burgov, N. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 182-7(July 1968). (In Russian).

Among the various methods used for the observation of the nonconservation of the time parity, that based on the Moessbauer effect has yielded the most accurate results. One of the variants of the method involves the study of mixed multipole transitions in a magnetic field. Following up O. C. Kistner's work, the mixed (E2 + M) emission of ^{99}Ru was used for the study; the excited state has a spin of $\frac{3}{2}$, while the ground state has a spin of $\frac{5}{2}$. A solid solution of metallic ruthenium containing 99.2% ^{99}Ru in iron was used as polarizer. At a concentration of 4.8 atomic %, a magnetic field of 500 kOe was generated, allowing observation of the Moessbauer effect. A high accuracy was expected on the basis of the experimental conditions. Similar experiments were also carried out with ^{193}Ir, but the results are not yet available. (TTT)

53144 SPINS OF LEVELS IN ^{33}P. Moss, C. E. (Duke Univ., Durham, N. C.); Poore, R. V.; Roberson, N. R.; Tilley, D. R. Phys. Rev., 174: 1333-7(Oct. 20, 1968).

The method-II angular-correlation technique of Litherland and Ferguson was applied to the reaction ^{30}Si(α,pγ)^{33}P to determine J^π for the following levels in ^{33}P: $\frac{3}{2}^+$ (1.44 MeV), $\frac{5}{2}^+$ (1.85 MeV), and $\frac{3}{2}^+$ (2.54 MeV). Mixing and branching ratios for the γ decays of these states were also obtained. The γ-ray spectrum was examined with a Ge(Li) detector to determine the following excitation energies for these states: 1.435 ± 0.003, 1.850 ± 0.003, and 2.544 ± 0.004 MeV. (auth)

53145 ANGULAR DISTRIBUTIONS OF THE RECOIL NUCLEI FROM THE ^{65}Cu(p,pn)^{64}Cu REACTION AT 0.37, 1.0, AND 2.8 GeV. Remsberg, L. P. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1338-42(Oct. 20, 1968).

Angular distributions of the recoil nuclei from the ^{65}Cu(p,pn)^{64}Cu reaction at incident proton energies of 0.37, 1.0, and 2.8 GeV were measured, and each was found to consist of a narrow sidewise peak on a gently sloping background. The most probable angle increases from 75° at 0.37 GeV to 85° at 2.8 GeV. The peaks are interpreted as resulting from a mechanism of inelastic scattering followed by neutron evaporation. They are thus taken to support the concept that the various mechanisms for nucleon, 2-nucleon reactions contribute independently, without interference, to the total cross sections for these reactions. The cross section in the peak was found to be about 0.3 of the total cross section at each of the three energies. (auth)

53146 EVIDENCE FOR A 0^+ STATE IN ^{68}Zn POPULATED BY ^{68}Ga. Carter, H. K. (Vanderbilt Univ., Nashville); Hamilton, J. H.; Ramayya, A. V.; Pinajian, J. J. Phys. Rev., 174: 1329-33 (Oct. 20, 1968).

The γ rays following the decay of ^{68}Ga in equilibrium with ^{68}Ge were studied with a 15-cc Ge(Li) detector in conjunction with a 4096-channel analyzer and with a Ge(Li)–NaI(Tl) coincidence arrangement. γ rays assigned to the decay of ^{68}Ga are as follows (energies in keV, relative intensities in parentheses): 578.3 ± 1.0 (1.1), 805.8 ± 0.6 (2.8), 1077.4 ± 0.2 (100), 1261.3 ± 0.3 (2.9), 1746.4 ± 1.0 (0.28), 1883.5 ± 0.4 (4.1), and 2338 ± 2 (0.4). The observed levels in ^{68}Zn are as follows: 1077.4 ± 0.2, 1655.7 ± 1.0, 1883.4 ± 0.3, 2338.7 ± 0.4, and 2823.8 ± 1.0 keV. The 578.3-keV transition and the level at 1655.7 keV it depopulates are previously unreported in the β decay of ^{68}Ga. γ-γ directional-correlation measurements were carried out with a Ge(Li) detector in one channel. The A_2 and A_4 coefficients for the 578.3-1077.4-keV cascade were measured to be 0.21 ± 0.14 and 1.35 ± 0.27, respectively. From these results, the 1655.7-keV level is uniquely assigned a spin of 0. (auth)

53147 PROJECTED TAMM–DANCOFF SPECTRA OF ^{20}Ne AND ^{24}Mg. Satpathy, L. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., 174: 1324-8(Oct. 20, 1968).

From the static Hartree-Fock solutions for ^{20}Ne and ^{24}Mg, the intrinsic wave functions of the excited bands are obtained in the Tamm–Dancoff approximation (TDA). For both the ground and excited states, axially symmetric deformation has been assumed. A phenomenological interaction with Yukawa radial dependence and exchange mixture of the Rosenfeld type is used in the calculation. The good angular-momentum states are then projected out from the TDA wave functions. The agreement between the calculated and the experimental spectra of ^{20}Ne is only reasonably good. Contrary to expectation, the projected spectrum in one case deviates significantly from the $J(J + 1)$ law. (auth)

53148 GAMMA-RAY WIDTHS OF THE 3.00-MeV LEVEL OF ^{27}Al AND THE 3.13-MeV LEVEL OF ^{31}P. Robinson, S. W.; Swann, C. P.; Rasmussen, V. K. (Bartol Research Foundation, Swarthmore, Pa.). Phys. Rev., 174: 1320-3(Oct. 20, 1968).

Nuclear resonant scattering of bremsstrahlung by the 3.00-MeV level of ^{27}Al was observed. From comparison with resonant scattering by the 2.98-MeV level of ^{27}Al, and with the branching taken from the literature as Γ_0/Γ = 0.87, widths Γ_0 = 5.3 ± 1.0 MeV and Γ = 6.1 ± 1.2 MeV are obtained. These values are in some disagreement with inelastic electron scattering results. Comparison with Doppler-shift values tends to verify spin = $\frac{9}{2}$ for the 3.00-MeV level and to rule out spin = $\frac{3}{2}$. Self-absorption measurements of the resonant scattering by the 2.21- and 2.98-MeV levels of ^{27}Al give Γ = 17.6 MeV and Γ = 125 MeV, in agreement with previous results. Self-absorption measurements for the 3.13-MeV level of ^{31}P give Γ = 66.3 ± 7 MeV. (auth)

53149 GAMMA DECAY OF T = $\frac{3}{2}$ STATES IN ^{25}Al AND ^{29}P. Morrison, G. C. (Argonne National Lab., Ill.); Youngblood, D. H.; Bearse, R. C.; Segel, R. E. Phys. Rev., 174: 1366-74(Oct. 20, 1968).

The yield curve of the residual ^{25}Al activity from the ^{24}Mg(p,γ) reaction was used to locate the lowest two T = $\frac{3}{2}$ states in ^{25}Al at E_p = 5.864 ± 0.005 MeV, E_x = 7.916 ± 0.006 MeV and at E_p = 5.936 ± 0.005 MeV, E_x = 7.985 ± 0.006 MeV. Each of the resonances was narrower than the estimated 3-keV spread in the proton beam. Gamma-ray spectra were measured with a Ge(Li) detector at both resonances. The lower resonance shows strong, approximately equal transitions to the ground state and to the third excited state in ^{25}Al, as well as a weaker branch to the second excited state. The decay of the upper resonance is predominantly that to the ground state, but weaker branches go to the first and second states. The decay schemes support a $\frac{5}{2}^+$ assignment for the lower T = $\frac{3}{2}$ state and favor $\frac{1}{2}^+$ for the upper. Rough angular-distribution measurements on the ground-state γ ray further support these assignments and indicate that the radiations are close to pure M1. The various γ-ray transition probabilities are well explained by a rotational picture for the low T = $\frac{3}{2}$ states. Gamma spectra were also taken at the lowest T = $\frac{3}{2}$ resonance in ^{29}P, which had previously been located at E_x = 8.374 ± 0.005 MeV, and it was found to feed the first, second, and third excited states. (auth)

53150 INFLUENCE OF ANGULAR MOMENTUM ON THE DECAY OF THE ^{60}Ni COMPOUND NUCLEUS. Benveniste, J. (Aerospace Corp., San Bernardino, Calif.); Merkel, G.; Mitchell, A. Phys. Rev., 174: 1357-65(Oct. 20, 1968).

In an experiment designed to study the effect of angular momentum on compound-nucleus reactions, the ^{60}Ni compound nucleus was

produced at the same excitation energy by bombarding two different target nuclei: ^{56}Fe, with 20.7 MeV α particles, and ^{59}Co, with 16.3-MeV protons. When α-particle and proton emission spectra from the ^{60}Ni compound nucleus were separately measured at 10° intervals, the angular distributions were found to be generally symmetric about 90°. The α-particle-induced reactions, however, showed more compound-nucleus anisotropy than the proton-induced reactions. The experimental cross sections are compared with the predictions of the semiclassical compound-nucleus theory of Ericson and Strutinski. (auth)

53151 STUDY OF THE PARTICLES EMITTED FROM ^{75}Br COMPOUND NUCLEI FORMED IN TWO WAYS: $^{12}C + ^{63}Cu$ AND $^{16}O + ^{59}Co$. D'Auria, J. M.; Fluss, M. J.; Herzog, G.; Kowalski, L.; Miller, J. M.; Reedy, R. C. (Columbia Univ., N. Y.). Phys. Rev., 174: 1409-12(Oct. 20, 1968).

This study is directed toward an investigation of how far the modes of decay of a compound nucleus are independent of its mode of formation. To this end, measurements were made of the energy and angular distributions of the protons and α particles emitted from ^{75}Br compound nuclei at an excitation energy of 49 MeV formed in two different ways: $^{12}C + ^{63}Cu$ and $^{16}O + ^{59}Co$. Optical-model analyses indicated near congruence of the angular momentum spectra of the ^{75}Br compound nuclei formed in these two entrance channels. The ratio of the cross section for the emission of protons with energies between 6 and 12 MeV to that for α particles between 10 and 20 MeV was found to be the same in both entrance channels. The shapes of the proton spectra as well as those of the α-particle spectra were also found to be independent of entrance channel. Thus, the mode of decay of the compound nuclei was found to be independent of the mode of formation for these reactions. (auth)

53152 ELECTRON SCATTERING STUDIES OF CALCIUM AND TITANIUM ISOTOPES. Frosch, R. F. (Stanford Univ., Calif.); Hofstadter, R.; McCarthy, J. S.; Noeldeke, G. K.; van Oostrum, K. J.; Yearian, M. R.; Clark, B. C.; Herman, R.; Ravenhall, D. G. Phys. Rev., 174: 1380-99(Oct. 20, 1968).

Experimental results are presented on the scattering of 250-MeV electrons by ^{40}Ca, ^{42}Ca, ^{44}Ca, ^{48}Ca, and ^{48}Ti, and of 500-MeV electrons by ^{40}Ca and ^{48}Ca. An analysis is made in terms of a phenomenological three-parameter shape, and a new, more accurate charge distribution is obtained for ^{40}Ca. The experiments also lead to a detailed exploration of the radial dependence of the differences in charge distributions of the various isotopes. Implications for nuclear theory are discussed. Comparison is made with the results of other electron scattering and of muonic x-ray experiments. The latter comparison permits an independent determination of an upper limit on the muon electromagnetic radius $\langle r^2 \rangle_\mu^{\frac{1}{2}} \lesssim 0.35$ F. (auth)

53153 POSITRON SPECTRUM OF ^{22}Na AND THE REST MASS OF THE NEUTRINO FROM β^+ DECAY. Beck, E.; Daniel, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys., 216: 229-31(1968). (In German).

The β^+ spectrum of ^{22}Na was measured with the Heidelberg $(\pi/2)\sqrt{13}$ iron-free β-ray spectrometer. Particular attention was paid to the upper end of the continuum. The maximum energy was found to be $E_{max} = 545.7 \pm 0.5$ keV. The rest mass of the neutrino connected with β^+ decay was found to be zero with an upper limit of 4.1 keV (67 percent confidence). (auth)

53154 ELASTIC SCATTERING OF 1.5-MeV NEUTRONS ON NUCLEI OF AVERAGE ATOMIC WEIGHT. Korzh, I. A.; Mishchenko, V. A.; Pasechnik, M. V.; Pravdivyi, N. M.; Sanzhur, I. E.; Totskii, I. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 12: 1571-3(1967). (In Russian).

Neutrons from a T(p,n)^{3}He reaction struck targets of Ti, Cr, Fe, Co, Ni, and Cu. The scattered neutrons were counted simultaneously on two proportional counters filled with methane. The inelastically scattered neutrons were eliminated from counting by electronic discrimination. The differential cross sections were measured for eight scattering angles over a range of 30 to 140°, and were corrected for neutron attenuation in the sample and for multiple neutron scattering. The measured angular distributions of the elastically scattered neutrons were analyzed on the basis of a six-parameter optical model of the nucleus, and it was found that the calculated values of the total cross sections and of the differential cross sections were in very good agreement with the experimental values. (TTT)

53155 THE DECAYS OF ^{53g}Fe AND ^{53m}Fe. Dernedde, Ingo (Univ., Goettingen, Ger.). Z. Phys., 216: 103-14(1968). (In German).

The γ-ray spectra from the decays of 8.5-min ^{53g}Fe and a new 2.51 ± 0.02-min ^{53m}Fe were investigated by means of Ge(Li) detectors. As far as the ^{53g}Fe decay is concerned, no other but the known 380-keV transition (43%) was observed, indicating that the preceding β^+ decay leads to the ground state and first excited state of ^{53}Mn only. This contradicts former β^+ spectroscopic results but is consistent with recent spin assignments. In the ^{53m}Fe decay, four γ transitions were found: 701 keV (100%), 1011 keV (76%), 1328 keV (76%), and 2339 keV (24%). The proposed level scheme of ^{53}Fe: 0 keV ($\frac{7}{2}^-$), 1328 keV ($\frac{9}{2}^-$), 2339 keV ($11/2^-$), and 3040 keV ($19/2^-$, 2.5 min) is in agreement with results published recently by Eskola. The level schemes of ^{53}Mn and ^{53}Fe are discussed in terms of the individual particle shell model. (auth)

53156 ABSOLUTE MEASUREMENTS OF X-RAY BEAM ENERGY AND PHOTONEUTRON CROSS SECTIONS FOR NATURAL Cu AND Pb. Tomimasu, Takio (Electrotechnical Lab., Tokyo). J. Phys. Soc. Jap., 25: 655-63(Sept. 1968).

Absolute determination of x-ray beam energy by cavity ionization chamber method was performed and absolute photoneutron cross sections for natural Cu and Pb were determined with an ETL quantameter and a 4-neutron detector using the x-ray beam from a 25-MeV betatron. Peak photoneutron cross sections for natural Cu and Pb are 78 ± 8 m at 17.2 MeV and 660 ± 60 mb at 14.1 MeV, respectively. These values are about 20% lower than the average cross section value obtained by several bremsstrahlung experiments. Cross sections for Cu and Pb are 1.81 mb/MeV from threshold to 24 MeV and 18.6 mb/MeV from threshold to 23 MeV, respectively. Using the contribution of the (γ,p) cross section for Cu, the ratios of σ_{-2} to 0.00225 $A^{\frac{5}{3}}$ mb/MeV for Cu and Pb are 0.95 ± 0.14 and 1.13 ± 0.17, respectively. (auth)

53157 ANOMALY IN THE PHOTODISINTEGRATION OF ^{58}Ni AND ^{60}Ni IN THE GIANT-DIPOLE RESONANCE REGION. Min, K.; White, Thomas A. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett., 21: 1200-2(Oct. 14, 1968).

The photoneutron cross sections for ^{58}Ni, ^{60}Ni, and natural nickel from threshold up to 25 MeV have been measured. The integrated (γ,n) cross section for ^{60}Ni is 2.6 times as large as the value for ^{58}Ni, and the two cross-section curves exhibit markedly different structure over the giant-dipole resonance region. The results suggest that it is important to include the shell effects explicitly in the theoretical treatment of the giant-dipole states in the medium nuclei such as nickel isotopes. (auth)

53158 PHOTOPROTONS FROM ^{23}Na, ^{31}P, ^{32}S, ^{40}Ca, ^{55}Mn, AND ^{56}Fe. Shoda, Katsufusa (Tohoku Univ., Sendai); Abe, Ken; Ishizuka, Takeo; Kawamura, Nobuaki; Oyamada, Masayuki; Sung, Baik-nung. J. Phys. Soc. Jap., 25: 664-74(Sept. 1968).

Energy and angular distributions of photoprotons from ^{23}Na, ^{31}P, ^{32}S, ^{40}Ca, ^{55}Mn, and ^{56}Fe irradiated with bremsstrahlung were measured using nuclear emulsions. The energy distributions indicate strong transitions to a few selected residual states. The angular distributions indicate that these states are hole states. (auth)

53159 SINGLE-PARTICLE STRENGTH OF COLLECTIVE 3^- STATE IN MEDIUM MASS NUCLEI. Matoba, Masaru (Kyoto Univ.). J. Phys. Soc. Jap., 25: 901(Sept. 1968).

Triton spectra and angular distributions from (α,t) reactions on ^{59}Co, ^{63}Cu, and ^{65}Cu at 29-MeV incident α energy were measured. The positions and strengths of 3^- states in the residual nuclei were determined. (D.C.W.)

53160 THE THERMAL NEUTRON ACTIVATION CROSS SECTION OF ^{59}Co. Merrit, Janet S.; Green, R. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 46: 2325-30(Oct. 15, 1968). (AECL-2735).

The 2200 m/s neutron activation cross section of ^{59}Co was determined with respect to ^{197}Au by irradiating gold and cobalt foils in a thermal neutron flux. The result for the production of 5.261-year ^{60}Co both directly and through ^{60m}Co is σ_0(activation) = 37.09 ± 0.27 b, based on a value of σ_0 = 98.7 b for ^{197}Au. Allowing for the ^{60m}Co that decays directly to levels in ^{60}Ni yields a value for the 2200 m/s capture cross section of σ_0(capture) = 37.14 ± 0.27 b. The standard deviation of the mean value of seven determinations was ±0.06%. The quoted error of ±0.27 b has been derived from estimates of systematic errors that are discussed. (auth) (CANADA)

53161 AVERAGE RECOIL RANGES OF ^{64}Cu AND ^{196}Au PRODUCED BY PROTONS OF 20 TO 85-MeV ENERGY IN ^{65}Cu AND ^{197}Au. Dewanjee, M. K.; Saha, G. B.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 46: 3157-70(Oct. 15, 1968).

Thick-target recoil experiments were performed to study (p,pn) reactions induced in ^{65}Cu and ^{197}Au in the energy range of 20 to 85 MeV, and the average ranges projected in the forward, backward, and perpendicular directions were determined. Recoil parameters were calculated to show approximately the amount of energy trans-

fer and their energy dependence. The average range results were compared with statistical theory, cascade-evaporation (85 MeV only), and inelastic scattering model calculations. The statistical calculations show reasonable agreement up to 30 to 40 MeV. However, the calculated projected range values, based on the cascade-evaporation and the inelastic scattering models, are consistently lower than the measured values. The analyses of the projected range values support the prevalent view that, at low energies (~30–35 MeV), the compound-nucleus mechanism is predominant and, at higher energies, the direct-interaction mechanism makes a major contribution. (auth) (CANADA)

53162 FISSION OF Ag AND Br NUCLEI IN 20-GeV/c PROTON INTERACTIONS. Deka, G. C.; Deka, K. C. (Cotton Coll., Gauhati, India). Can. J. Phys., 46: 2301-8(Oct. 15, 1968).

In the analysis of a sample of 1424 stars produced in nuclear emulsion by 20-GeV/c protons, 107 stars were found to contain short dense tracks, which were interpreted as due to nuclear fission. The mean range and velocity of the fission fragments were estimated to be ~9.9 μ and ~0.047 c, respectively, compared with ~4.8 μ and ~0.026 c, respectively for the residual recoils of ordinary stars. The average space angle between the products of binary fission is found to be 128°. (auth) (CANADA)

53163 EXPERIMENTAL INVESTIGATIONS ON THE ELECTRON-CAPTURE DECAY OF ^{54}Mn AND ^{65}Zn. Hammer, Johann Wolfgang (Institut fuer Strahlenphysik, Stuttgart). Z. Phys., 216: 355-71(1968). (In German).

The electron-capture decay of ^{54}Mn and ^{65}Zn was investigated using NaI(Tl) detectors. Spectroscopic-coincidence techniques were employed to examine the K-electron capture rates of ^{54}Mn and ^{65}Zn and the branching ratio and positron rate of ^{65}Zn. The experimental results are: $P_k\omega_k(Mn) = 0.2492 \pm 0.0017$, $P_k\omega_k(Zn) = 0.3927 \pm 0.0026$, $EC^e/EC^0(Zn) = 53.2 \pm 1.0/46.8 \pm 1.0$, $\gamma/\beta^+ = 35.1 \pm 1.7$, $K^0/\beta^+ = 27.7 \pm 1.5$. Thus electron capture to the excited state of ^{65}Cu occurs to the extent of 52.4 ± 1.0%, while electron capture and positron decay to the ground state were found to be associated with 46.1 ± 1.0% and 1.49 ± 0.05% of the disintegrations. These data partly disagree significantly from other measurements. Using the fluorescence yields $\omega_k(Cr) = 0.279$ and $\omega_k(Cu) = 0.4425$, deduced from other measurements, values of L + M/K of electron capture to the excited state could be derived: L + M/K(Mn 54) = 0.120 ± 0.015 and L + M/K(Zn 65) = 0.127 ± 0.015. These ratios agree with the calculations of Bahcall. The half-lives of ^{54}Mn and ^{65}Zn were determined to be $T_{\frac{1}{2}}$(Mn 54) = 312 ± 5 day and $T_{\frac{1}{2}}$(Zn 65) = 243 ± 4 day. The energy of the ^{65}Zn γ rays was measured with a Ge(Li) counter: $E_\gamma = 1115.5 \pm 0.5$ keV. (auth)

53164 AN EXPERIMENTAL STUDY OF LOW-ENERGY PROTONS FOLLOWING DEUTERON-INDUCED REACTIONS: SPECTRAL FLUCTUATIONS AND DECAY FROM ISOBARIC ANALOGUE STATES. Cue, Nelson Wong. Seattle, Univ. of Washington, 1967. 237p.

Thesis.

Low-energy protons (2.5 to 10 MeV) from deuteron-induced reactions on various targets were studied with the use of a ΔE-E detector telescope having a combined energy resolution of about 34 keV. The ^{27}Al(d,p)^{28}Al reaction leading to the continuum states was investigated in detail at deuteron energies around 16.5 MeV in an attempt to search for spectral fluctuations, i.e., fluctuations in the particle spectra corresponding to the continuum states in the residual nucleus. These fluctuations, in contrast to the conventional fluctuations in the excitation functions of reactions leading to a discrete final state, would be exhibited in a particle spectrum taken at a single bombarding energy. However, their observation requires a detection system resolution which is less than or roughly equal to the coherence width of the residual nucleus. Spectral fluctuations are predicted when the assumptions underlying the conventional fluctuation theory are extended to a situation of overlapping final states. Various correlation calculations were performed for the experimental proton spectra. The results indicated that the observed structure is not primarily attributable to spectral fluctuations, due to contributions from extraneous events corresponding to secondary emission between discrete energy levels. Arguments are presented to show that these extraneous events are mainly from the proton decay of the isobaric analogue states (IAS) formed in the ^{27}Al(d,n)^{28*}Si reaction. The cross sections were measured for proton decay from isobaric analogue states (T = T_z + 1) formed in the (d,n) reactions on the following targets: ^{90}Zr, ^{92}Zr, ^{94}Zr, ^{92}Mo, ^{94}Mo, ^{98}Mo, ^{114}Sn, ^{116}Sn, ^{118}Sn, ^{120}Sn, as well as ^{27}Al, ^{64}Ni, ^{66}Zn, ^{89}Y, ^{91}Zr, and ^{206}Pb. Excitation functions (θ_{lab} = 170°) were obtained with the deuteron energies ranging from the (d,n) threshold of the ground state analogue (typically ~7 MeV) to 16 MeV. Angular distributions at various bombarding energies were also obtained for the stronger transitions. The cross sections are large only for the reactions leading back to the target ground state and when the neutron decay channels are closed to the IAS. Particular attention is paid to the large variation in the cross sections for reactions which proceed through the analogues of $2d_{\frac{5}{2}}$, $3s_{\frac{1}{2}}$, and $2d_{\frac{3}{2}}$ states in the Zr, Mo, and Sn isotopes. At incident energies above several hundreds keV from the threshold, this variation is shown to be consistent with a sequential process in which the (d,n) formation mechanism is direct, when the decay through the spreading width is explicitly taken into account in the branching ratios. The overall energy dependence of the cross sections can be qualitatively understood if an additional mechanism such as a charge exchange process in the outgoing neutron channel of the (d,n) stripping reaction is considered. From the study of the ground state decay angular distributions of the $d_{\frac{5}{2}}$-IAS in ^{91*}Nb and ^{93*}Tc, it is shown that making strongly suggestive spin assignments to the IAS is sometimes feasible and that the extracted m-substate populations near threshold suggest the importance of spin-orbit interactions (or other spin dependent interactions) in the (d,n) formation mechanism. (Disser. Abstr.)

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Refer also to abstracts 51043, 51279, 53078, 53095, 53105, 53118, 53135, 53140, 53156, 53161, 53162, 53164, and 53228.

53165 (ANL–7425, pp 190-2) NUCLEAR CONSTANTS. (Argonne National Lab., Ill.).

Current progress is reported for neutron capture cross sections of reactor materials, capture-to-fission cross-section ratios of fissile and fertile materials irradiated in EBR-II, and preliminary investigations of tritium yields produced in fast neutron fission. (D.C.W.)

53166 (CEA-R-3385) STUDY OF SOME PROPERTIES OF "S" NEUTRON RESONANCE PARAMETERS FOR TARGET NUCLEI I = ½ AND I = 3/2 AS A FUNCTION OF SPIN VALUE J = I ± ½ IN THE ENERGY RANGE 1 → 5000 eV. Julien, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb. 1968. 267p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Faculte des Sciences, France.

Several types of experiments and methods of data analysis that can be used to obtain resonance parameters in the low-energy (1 to 5000 eV) range are described, and the results of an investigation of the spin systematics of the resonance parameters for I = ½ and I = 3/2 nuclei are presented. Efforts were made to improve experimental conditions and data processing in order to determine the spin value J = I ± ½. The time-of-flight method was used in the measurements. The dependence of the fluctuations of the total radiative width on the spin value is considered; the magnitude of the fluctuations is interpreted in terms of the strengths of the E1 transitions to the first excited states. The distributions of level spacings are compared to theoretical predictions. (D.C.W.)

53167 (CEA-R-3503) EXPERIMENTAL STUDY OF THE INTERACTION OF 14-MeV NEUTRONS WITH ^{238}U. Voignier, Jean-Jacques (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). July 1968. 55p. (In French). Dep.

A study was made of the interaction of fast neutrons with natural uranium from the experimental point of view over a wide energy range. The scattering energy spectra were obtained by the time-of-flight method. The cross section σ_t, the elastic cross section σ_e, and the inelastic neutron emission cross section σ_{ne} were measured at 14 MeV. The average number, η, of neutrons produced by interaction was deduced from this last measurement. The fission spectrum and the evaporation spectrum were deduced from the energy spectrum of the secondary neutrons. The values obtained for the various cross sections are compared with previous results. (auth)

53168 (JAERI–1162) ON THE EVALUATION OF ^{239}Pu DATA IN THE keV AND RESOLVED RESONANCE REGION. Durston, C. (Atomic Energy Establishment, Winfrith (England)); Katsuragi, S. (Japan Atomic Energy Research Inst., Tokai, Tokai Research Establishment). June 1968. 10p. Dep.

The evaluation for ^{239}Pu cross sections in the keV region is described. The present evaluation gives a better interpretation to both the α value and the fission cross section. This evaluation confirms the applicability of the channel theory of fission. In the resolved resonance regions a fit to the cross section is obtained that is suitable for use with the GENEX code. For users convenience, the resonance parameters are listed. (auth)

53169 (PPAD-647-D) NUCLEAR CHEMISTRY RESEARCH AT PRINCETON UNIVERSITY. Annual Progress Report, 1967-1968. Thomas, T. D.; Spejewski, E. H.; Naumann, R. A. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Aug. 5, 1968. Contract AT(30-1)-2137. 69p. Dep. CFSTI.

The decays of ^{205}At, ^{105}Cd, I isotopes, Po isotopes, and ^{193}Pt were investigated; information on the energy levels of Bi isotopes, ^{105}Ag, and Te isotopes was obtained. The production of ^{19}N and ^{21}O in the fragmentation of Au by 3-GeV protons was observed. Fission fragment-γ coincidences in the spontaneous fission of ^{252}Cf were studied. The effects of deformation on the Coulomb barrier were investigated using the liquid-drop model. The use of the Moessbauer effect to study particle motion in suspensions was studied. A search for particles with velocities greater than the velocity of light was initiated; an attempt was made to observe the emission of Cherenkov radiation. The nucleosynthesis of He in low-density hydrogen gas was studied theoretically. A holder for radioactive targets was developed. Ion sources for isotope separators were developed; the utilization of ^{252}Cf as a cold ion source was attempted. A chemical and structural investigation of the fluorides and oxyfluorides of Tc was undertaken. (D.C.W.)

53170 SEARCH FOR DOUBLE ELECTRON EJECTION IN THE ELECTROMAGNETIC DECAY OF ^{113m}In. Sommer, H.; Knauf, K.; Klewe-Nebenius, H. (Univ., Heidelberg). Z. Phys., 216: 153-64(1968). (In German).

An electromagnetic transition between two nuclear states may proceed through simultaneous ejection of two atomic electrons. This process was searched for in the decay of ^{113m}In by means of two lithium-drifted silicon detectors and a two-dimensional pulse-height analysis. No evidence for double electron ejection was found. From background analysis, however, upper intensity limits relative to normal single K-conversion were derived for different modes of the double decay. The intensity of double K-electron ejection with electron energies between 68 and 267 keV was determined to be less than 2.0×10^{-5}. This limit was compared with theoretical estimates. In addition, the following limits were obtained: 1.8×10^{-4} for simultaneous emission of a K- and a L-electron, the energies ranging from 79 to 280 keV, and 2.9×10^{-5} for simultaneous emission of two L-electrons with energies between 91 and 292 keV. (auth)

53171 EVIDENCE FOR A NEW 0^+ LEVEL IN ^{154}Gd. Hamilton, J. H. (Vanderbilt Univ., Nashville, Tenn.); Manthuruthil, J. C. Nucl. Phys., A118: 686-8(1968).

The K electron intensities of the 533.6 ± 0.5-, 676.5 ± 0.4-, 681.5 ± 0.5-, and 692.5 ± 0.3-keV transitions were measured. The 533.6- and 681.5-keV transitions are pure E0. (auth)

53172 ELECTRON SPECTROSCOPY STUDIES OF THE DECAY OF ^{154}Eu. Brantley, W. H. (Vanderbilt Univ., Nashville, Tenn.); Hamilton, J. H.; Katoh, T.; Zganjar, E. F. Nucl. Phys., A118: 677-85(1968).

The relative conversion electron intensities of 16 transitions between 440 and 1280 keV were measured in an iron-free double-focusing spectrometer. The K conversion coefficients of the nine strongest transitions were measured by the internal-external conversion method, and multipole assignments of these transitions were made. The conversion electron intensities of the 676- and 692-keV transitions between the 4^+ and 2^+ levels of the K = 0 vibrational band and the 4^+ and 2^+ levels for the ground-state rotational band, respectively, were found to be about 90% E0 radiation. Transitions of 534 and 681 keV are assigned to be pure E0. (auth)

53173 NUCLEAR MATRIX ELEMENTS FOR THE BETA DECAY OF ^{198}Au AND ^{122}Sb. Manthuruthil, J. C.; Poirier, C. P. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Nucl. Phys., A118: 657-76(1968).

All presently available experimental data on the spectrum shape factor, β-γ directional correlations, β-circularly polarized γ correlations, and angular distribution of γ rays from oriented nuclei in the first-forbidden beta transitions of ^{198}Au and ^{122}Sb to the first excited states in ^{198}Hg and ^{122}Te, respectively, were used to obtain the nuclear matrix elements parameters x, u, ξ'y, w and ξ'v. The analysis was based on the theoretical expressions given by Morita and Morita using exact electron radial wave functions which include finite nuclear size corrections. In the case of ^{198}Au, a unique set of parameters was found; but for ^{122}Sb, two sets of parameters were found that fit the data equally well. These parameters are: for ^{198}Au, x = 0.047 ± 0.006, u = −0.097 ± 0.008, ξ'y = −1.95 ± 0.21; w = 0.20 ± 0.09 and ξ'v = −4.43 ± 1.26; for ^{122}Sb, Set I, x = −0.06 ± 0.06, u = 0.08 ± 0.10, ξ'y = 1.15 ± 0.57, w = 4.83 ± 0.55 and ξ'v = 54.7 ± 5.8; Set II, x = 0.01 ± 0.05, u = 0.10 ± 0.11, ξ'y = 0.06 ± 0.6, w = 2.47 ± 0.50 and ξ'v = −29.3 ± 5.8. However, it is shown that in the case of ^{122}Sb, a determination of β-circularly polarized γ-correlation as a function of energy can eliminate one set. For both ^{198}Au and ^{122}Sb, the observed values of the matrix elements are not in agreement with single-particle predictions. However, in the case of ^{122}Sb, they are in agreement with the predictions of Kisslinger and Wu. (auth)

53174 GIANT-DIPOLE-RESONANCE ABSORPTION AND RADIATIVE STRENGTH FUNCTION OF ^{196}Pt. Rosenzweig, N. (Argonne National Lab., Ill.). Nucl. Phys., A118: 650-6(1968).

The value of the radiative strength function observed in (n,γ) reactions at the neutron binding energy is compatible with the value deduced from the inverse (γ,n) reaction with the help of the hydrodynamical model. An analysis of the observed energy dependence of the radiative strength function suggests that the family of displaced resonance-absorption curves based on the various excited states of ^{196}Pt has roughly similar shapes in the excitation energy range from 6.3 to 7.9 MeV. More generally, it is made plausible that the value of a certain mean energy should be displaced by an amount precisely equal to the energy displacement of the initial state. (auth)

53175 THE EXCITED STATES OF THE ODD NUCLEI ^{190}Au AND ^{192}Au. Kilcher, P. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A118: 628-40(1968). (In French).

Excited levels of ^{190}Au and ^{192}Au were studied by measuring γ spectra and e^--γ coincidences with Ge(Li) and Slätis-Siegbahn β^- spectrometers. Intensities, α_K conversion coefficients, and multipolarities were determined. The level schemes are established. The experimental results obtained are not yet sufficient to explain the large number of levels of these odd nuclei. It seems that the levels can not be explained in terms of the spherical shell model. (auth)

53176 DIPOLE STATES IN DEFORMED NUCLEI. Feifrlik, V.; Rizek, J.; Vogel, P. (Nuclear Research Inst., Rez, Czech.). Nucl. Phys., A119: 1-13(1968).

Energies and other characteristics of the dipole states with $K^\pi = 1^-$ and 0^- of the doubly even deformed nuclei in the rare-earth region were investigated. The calculations were performed by using the method of finite Fermi-system theory. It was shown that with reasonable values of the interaction constants, good agreement with the experimental values of the energy and energy splitting of the giant resonance can be achieved. The integrated γ-absorption cross section is close to the theoretical value given by the sum rules. The influence of the superfluid pairing correlations is small as well as that of the interaction in the particle-particle channel. (auth)

53177 HYPERFINE STRUCTURE OF THE Ba II-RESONANCE LINES AND THE QUADRUPOLE MOMENTS OF THE ODD BARIUM ISOTOPES. Becker, W.; Fischer, W.; Huehnermann, H. (Univ., Marburg, Ger.). Z. Phys., 216: 142-52(1968). (In German).

By means of a photoelectric registering Fabry-Pérot-interferometer and using enriched Ba isotopes, the hyperfine structure of the barium II-resonance lines $6p^2P_{\frac{3}{2},\frac{1}{2}} - 6s^2P_{\frac{1}{2}}$, λλ4554; 4934 Å was investigated. The following results were obtained by digital data processing of the registered interference curves: $A(^{135}Ba, 6s^2S_{\frac{1}{2}}) = 119.78(10)$ mK, $A(^{137}Ba, 6s^2S_{\frac{1}{2}}) = 133.94(11)$ mK, $A(^{135}Ba, 6p^2P_{\frac{1}{2}}) = 22.14(8)$ mK, $A(^{135}Ba, 6p^2P_{\frac{3}{2}}) = 3.77(7)$ mK; and $B(^{135}Ba, 6p^2P_{\frac{3}{2}}) = 2.1(3)$ mK. For the quadrupole moment of ^{135}Ba the value of $Q(^{135}Ba) = 0.17(2) \times 10^{-24}$ cm^2 was calculated (without Sternheimer correction). This result should not be strongly affected by perturbations in the p-terms of alkali-like spectra of heavy elements and by the uncertainty of the relativistic corrections. The isotope shift of the odd Ba isotopes with respect to ^{138}Ba was remeasured. (auth)

53178 CORRECT USE OF CVC THEORY IN FIRST-FORBIDDEN β^- DECAY OF ^{186}Re, ^{188}Re, AND ^{170}Tm CONSIDERING THE WOODS-SAXON SUPERFLUID CORRECTIONS. Bogdan, D.; Protop, C.; Vata, L. (Inst. for Atomic Physics, Bucharest). Nucl. Phys., A119: 113-30(1968).

It is shown that for the ^{186,188}Re β^- transitions, the Woods-Saxon and Nilsson wave functions give practically the same theoretical predictions for the nuclear parameters and the observables except the ft values. Moreover, a correct use of the formula connecting the $\int$ a and $\int$ ir matrix elements as well as the Fujita estimation of this formula yields results in agreement with experiment in contrast to the ^{170}Tm case. The superfluid corrections taking into account the blocking effect have been calculated for these transitions using the Woods-Saxon wave functions. They are in an appreciable manner smaller than the Nilsson ones. (auth)

53179 A COMPARISON OF REACTIONS INDUCED BY MEDIUM-ENERGY ^{3}He AND ^{4}He IONS IN HEAVY TARGET NUCLEI. Scott, N. E.; Cobble, J. W.; Daly, P. J. (Purdue Univ., Lafayette, Ind.). Nucl. Phys., A119: 131-45(1968).

Induced activity methods were used to measure the cross sections of many reactions induced by 10- to 33-MeV ^{3}He ions and

10- to 44-MeV ^{4}He ions on a number of target nuclei in the mass range A = 180 to 210. It is shown that (^{4}He,xn) reactions account for more than 90% of the optical-model total reaction cross section in this mass region, and that these reactions proceed predominantly by compound nuclear mechanisms. On the other hand, (^{3}He,xn) reactions account for only about half of the ^{3}He ion total cross section. Using the independence hypothesis, it is argued that at least 40% of all reactions induced by ^{3}He ions in these nuclei involve charged-particle emission, and that direct reaction mechanisms are dominant. With the possible exception of the (^{3}He,n) reaction, the (^{3}He,xn) results are consistent with compound nuclear reaction mechanisms. (auth)

53180 LEVELS IN THE N = 82 NUCLEUS ^{139}La POPULATED IN ^{139}Ba DECAY. Hill, John C.; Wiedenbeck, M. K. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A119: 53-64(1968).

The decay of ^{139}Ba to levels in ^{139}La was investigated using Ge(Li) gamma-ray detectors. On the basis of energy, intensity and coincidence measurements, a new decay scheme is proposed. In addition to well-known levels at 166 and 1420 keV, 12 new levels between 1200 and 2100 keV were observed. The results are compared with those for other odd-mass N = 82 isotones. (auth)

53181 ELASTIC AND INELASTIC PROTON SCATTERING FROM $^{112\ 114}$Cd. Stelson, P. H.; Ford, J. L. C. Jr.; Robinson, R. L.; Wong, C. Y.; Tamura, T. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A119: 14-26(1968).

Differential cross sections for elastic and inelastic scattering of 13-MeV protons by ^{112,114}Cd were measured. Special effort was made to extract cross sections for the excitation of states which occur in the two-phonon region. The elastic scattering was fitted by searching for the best parameters of an optical model. The observed cross sections for excitation of the one-phonon 2^+ and 3^- states were compared to the predictions of both the DWBA theory and the coupled-channel theory. Distortion parameters were extracted and compared to the electromagnetic values. The differential cross sections for excitation of the two-phonon states are very similar for the two cadmium isotopes, and they are also similar to those previously observed for the palladium isotopes. The coupled-channel theory is used to interpret the excitation of the two-phonon states. An appreciably better fit to the observed cross sections for excitation of the second 2^+ states is obtained if a small admixture of the one-phonon state is assumed for the description of these states. (auth)

53182 ENERGY LEVELS OF ^{237}U. Ahmad, Irshad; Friedman, A. M.; Unik, J. P. (Argonne National Lab., Ill.). Nucl. Phys., A119: 27-39(1968).

The alpha decay of ^{241}Pu was investigated using high-resolution semiconductor detectors in conjunction with coincidence techniques. The observed α-particle and γ-ray transition energies and intensities were found to be consistent with the previously known energy levels of ^{237}U. The half-life of the $\frac{5}{2}^+(622\uparrow)$ state (at 160.0 keV) in ^{237}U was measured by an α-γ delayed coincidence technique and found to be 3.1 ± 0.1 nsec. The half-life of the 274-keV level, which de-excites by emission of a 114 ± 1 keV γ ray was also measured by an α-γ delayed coincidence method and has a value of 155 ± 6 nsec. Three alpha groups populating the 274-keV state and its rotational members were identified in an α spectrum measured in coincidence with γ rays emitted 50 to 200 nsec after the emission of α particles. By analogy with the energy levels of ^{239}Pu, the 274-keV level was given a Nilsson-state assignment of $\frac{7}{2}^-(743\uparrow)$. (auth)

53183 NEUTRON RADIUS IN Pb FROM THE ANALOG STATE. Bethe, H. A.; Siemens, P. J. (Cornell Univ., Ithaca, N. Y.). Phys. Lett., 27B: 549-51(Sept. 30, 1968).

The energy of the analog state is re-evaluated, taking into account that the neutrons in the outermost shell are converted into protons. The half-density radius of neutrons is found to be 0.2 fm less than that of the protons. (auth)

53184 ISOMER SHIFTS ON THE $2^+ \rightarrow 0^+$ ROTATIONAL TRANSITION OF ^{154}Gd. Gal, J. (Nuclear Research Center, Negev, Israel); Bauminger, E. R.; Ofer, S. Phys. Lett., 27B: 552-3(Sept. 30, 1968).

Moessbauer measurements of isomer shifts on the $2^+ \rightarrow 0^+$ rotational transitions of ^{154}Gd and ^{158}Gd were carried out. The results show that $\delta\langle r^2\rangle_{154}/\delta\langle r^2\rangle_{158} = 0.7^{+\frac{1}{3}}_{-\frac{1}{3}}$. This result is compared with existing theoretical values. (auth)

53185 INTERMEDIATE STRUCTURE IN THE DEPENDENCE OF ^{236}U FISSION PROBABILITY ON EXCITATION ENERGY. Vorotnikov, P. E. Yadern. Fiz., 8: 214-16(July 1968). (In Russian).

The dependence of the fission cross section σ_f of heavy elements, such as the Th, Pa, and U isotopes, on the excitation energy E* in the threshold region, exhibits clearcut steps and maxima. This behavior of $\sigma_f(E^*)$ has been attributed to the structure of the fission width Γ_f, related to the quasistable state of the compound nucleus which affects the fission probability. The problem was further examined by studying the neutron-induced fission of ^{236}U, correlating the relevant data on the formation of the compound nucleus σ_c, the fission cross section σ_f, and the radiative capture cross section σ_γ. The experimental findings were found to contradict the theoretical predictions; the results can be explained only by assuming that the wide maxima of the previously plotted $\overline{\Gamma}_f(E^*)$ curve has a better fine structure, due to the excitation of states, that is distinct from the quasistable states of the compound nucleus. (TTT)

53186 STUDY OF THE GAMMA DECAY OF THE FIRST $d_{\frac{5}{2}}$ ANALOG STATE IN ^{91}Nb. Rauch, F. (Bartol Research Foundation, Swarthmore, Pa.). Phys. Lett., 27B: 560-2(Sept. 30, 1968).

The E1 γ decay of a $d_{\frac{5}{2}}$ analog state in ^{91}Nb was observed in the reaction ^{90}Zr(p,γ_1)^{91}Nb. The radiative width of this state was found to be 27 ± 14 eV. (auth)

53187 MEASUREMENT OF INTERNAL CONVERSION K/L_3 AND K/L RATIOS FOR E2 TRANSITION. Bogdanovic, M.; Mladjenovic, M.; Stepic, R. (Kidric Inst. of Nuclear Sciences, Belgrade). Z. Phys., 216: 267-73(1968).

Internal conversion K/L_3 ratios for E2 transitions were measured for nuclei with mass numbers from 152 to 198, and the energy interval of 80 to 500 keV. The results of all the 11 transitions measured are in good agreement with theoretical values. (auth)

53188 THE NUCLIDE ^{193}Bi. Hanser, A.; Freitag, K. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 9: 51-3 (1968). (In German).

Within the framework of a study on the decay of neutron-deficient Bi isotopes of low mass number, the nuclide ^{193}Bi was prepared and identified. The methods used for the preparation and identification are described. The half-life was measured to be 11.85 ± 0.18 min. The γ spectrum obtained is given. The existence of the strong x-ray K line, the lack of a clear 511-keV annihilation radiation, and the fact that four strong γ transitions are converted into Pb indicates that the prinicpal decay of ^{193}Bi is the conversion into ^{193}Pb by electron capture. (J.S.R.)

53189 RELATIVE MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF THE β-PARTICLES OF ^{152}Eu. Huster, Erich; Wallek, Lothar; Hoffmann, Wolfgang (Univ., Muenster, Ger.). Forschungsber. Landes Nordrhein-Westfalen, No. 1942, 1-28(1968). (In German).

The polarization of β particles from ^{152}Eu was measured relative to the polarization of β particles from ^{32}P using angular correlation techniques. (D.C.W.)

53190 TOTAL NEUTRON CROSS-SECTION MEASUREMENTS IN THE 10 μeV RANGE. Palmgren, A. (Technical Univ. of Helsinki); Krebs, K.; Tunkelo, E. Phys. Lett., 27B: 554-6(Sept. 30, 1968).

Total neutron cross-sections of Cd near λ = 10 nm (E_n = 8 μeV) were measured with the "Doppler chopper" method, in which a moving sample is attached to the rotor which simultaneously performs the neutron velocity selection. (auth)

53191 OBSERVATION OF THE MOESSBAUER EFFECT IN ^{232}Th FOLLOWING COULOMB EXCITATION. Hershkowitz, N.; Jacobs, C. G. Jr.; Murphy, K. A. (Univ. of Iowa, Iowa City). Phys. Lett., 27B: 563-4(Sept. 30, 1968).

The Moessbauer effect of ^{232}Th was observed following Coulomb excitation. A lower limit for the lifetime was found to be 0.33 ± 0.01 ns. No isomer shift greater than 0.5 mm/s was detected. (auth)

53192 NEUTRON CROSS SECTIONS AND RESONANCE PARAMETERS OF Yb ISOTOPES. Mughabghab, S. F.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1400-8(Oct. 20, 1968).

Neutron transmission measurements were carried out for ^{170}Yb, ^{171}Yb, ^{172}Yb, ^{173}Yb, ^{174}Yb, and ^{176}Yb over a large energy region to determine the s-wave strength functions, level densities, scattering-radius parameters, and thermal cross sections. The values of the latter are found to be 17.0 ± 1.0, 57 ± 3, 10.2 ± 1.5, 28 ± 2, 142 ± 5, and 14.9 ± 1.0 b, respectively. From these, a paramagnetic scattering cross section of 5.2 ± 0.9 b is extracted for Yb^{3+} at 0.0253 eV. By comparing the level densities of ^{171}Yb and ^{173}Yb, a spin cutoff factor σ = 2.8 ± 0.8 b is derived. Average total cross sections are analyzed to determine the strength functions in the 5 to 15-keV region, which are compared with values derived in the low-energy region. (auth)

53193 NEUTRON SCATTERING CROSS SECTIONS OF ^{233}U, ^{235}U, AND ^{241}Pu FROM 1 TO 30 eV. Sauter, G. D. (Univ. of

California, Davis); Bowman, C. D. Phys. Rev., 174: 1413-20 (Oct. 20, 1968).

Scattering cross sections for ^{233}U, ^{235}U, and ^{241}Pu were measured for neutron energies between 1 and 30 eV, using the 4π neutron source technique. For ^{241}Pu, the scattering cross section and published fission data were simultaneously fitted with Reich and Moore's multilevel formula. A good fit to both cross sections was obtained after allowing a sizable fluctuation in the resonance capture widths. Spin assignments were made for all observed resonances in the 2 to 32-eV interval. The average fission width for the J = 2 levels is 510 MeV and for the J = 3 levels is 190 MeV, in accordance with the spin-fission width correlation predicted by the Bohr–Wheeler theory. (auth)

53194 STUDY OF THE $^{93}Nb(n_{res},\gamma)^{94}Nb$ REACTION. Prestwich, W. V.; Cote, R. E.; Shwe, Hla (Argonne National Lab., Ill.). Phys. Rev., 174: 1421-6(Oct. 20, 1968).

The high-energy γ-ray spectra following capture in one s-wave and three p-wave resonances in Nb were observed with a Ge(Li) detector. The low-lying energy levels of ^{94}Nb inferred from the data are consistent with those previously reported on the basis of (d,p) and low-energy (n,γ) data. From the observed decay properties of the initial states, the spin assignments for the resonances are inferred to be $J_\gamma^\pi = 5^-$ (35.8 eV), 4^+ (119.2 eV), 4^- or 5^- (42.3 eV), 3^- or 4^- (94.3 eV). The distribution of partial radiative widths for the three p-wave resonances is consistent with that predicted by the statistical compound-nucleus model. (auth)

53195 TEST OF TIME-REVERSAL INVARIANCE VIA A β-γ-γ ANGULAR CORRELATION IN $^{106}Rh-^{106}Pd$. Perkins, R. B.; Ritter, E. T. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 174: 1426-8(Oct. 20, 1968).

A measurement of the relative phase angle η between the E2 and M1 reduced matrix elements in the 1.050-MeV transition of ^{106}Pd was made by means of a β-γ-γ angular correlation. Instrumental and background asymmetries in the data were carefully measured and found to be negligible. A value $\sin\eta = +0.004 \pm 0.018$ was obtained. Time-reversal invariance requires $\sin\eta \equiv 0$; thus, the present result is consistent with no violation of time-reversal invariance. (auth)

53196 ELASTIC AND INELASTIC PROTON SCATTERING FROM EVEN ISOTOPES OF Cd, Sn, AND Te. Makofske, W.; Savin, W.; Ogata, H.; Kruse, T. H. (Rutgers, The State Univ., New Brunswick, N. J.). Phys. Rev., 174: 1429-41(Oct. 20, 1968).

Protons of 16-MeV energy were scattered from isotopically enriched targets of $^{110,112,114,116}Cd$, $^{112,116,118,120,122,124}Sn$, and $^{126,128,130}Te$. Differential cross sections were measured for scattering to the 0^+ ground state and the first 2^+ and 3^- collective states. As the mass number A increases, the elastic angular distributions shift towards smaller angles and show increasing damping. The 2^+ and 3^- cross sections show a systematic decrease in magnitude with increasing A. Optical-model calculations were made by fixing the geometrical parameters for each set of isotopes and searching on V and W_D, the real and surface imaginary parts of the optical potential. The observed trends, systematically increasing with A, are consistent with an isospin dependence in the real and imaginary parts of the optical potential. The distorted-wave program DWUCK, assuming a collective vibrational model, was run using complex coupling and Coulomb excitation in order to extract deformation parameters β_l for all the 2^+ and 3^- states. These parameters indicate that the decrease in inelastic scattering with increasing A is associated with a decreasing collectivity for each set of isotopes. The values of β_l are in reasonable agreement with deformation parameters extracted by other methods. (auth)

53197 LEVELS IN EVEN–EVEN ^{192}Hg, ^{194}Hg, ^{196}Hg, AND ^{198}Hg. Petry, R. F.; Naumann, R. A.; Evans, J. S. (Princeton Univ., N. J.). Phys. Rev., 174: 1441-54(Oct. 20, 1968).

The decay of the 2^- and 7^+ isomeric states of ^{192}Tl, ^{194}Tl, ^{196}Tl, and ^{198}Tl was studied, using isotopically separated sources produced by high-energy proton spallation of lead and uranium targets. γ-ray and conversion-electron spectra were recorded, and extensive coincidence measurements helped to establish the energy levels that are populated in the corresponding mercury daughter nuclides. Level schemes for ^{192}Hg, ^{194}Hg, ^{196}Hg, and ^{198}Hg deduced from the data are presented and are discussed. (auth)

53198 FISSION OF ^{238}U BY 2.2-GeV PROTONS. Crespo, V. P.; Cumming, J. B.; Poskanzer, A. M. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1455-71(Oct. 20, 1968).

Angular distributions and differential range curves at angles of 15, 90, and 165° were obtained by radiochemical methods for several representative products which recoil out of thin uranium targets irradiated with 2.2-GeV protons. Mean momenta observed at 90° to the beam direction are 133, 125, and 125 (MeV amu)$^{\frac{1}{2}}$ for the neutron-excess isotopes ^{140}Ba, ^{99}Mo, and ^{91}Sr, but only 96 and 104 (MeV amu)$^{\frac{1}{2}}$ for the neutron-deficient products ^{131}Ba and ^{103}Pd. The neutron-deficient isotopes have broader momentum distributions and more forward-peaked angular distributions than do the neutron-excess products. Results are discussed in terms of a two-step vector model, i.e., a fast nucleonic cascade followed by fission or another slower de-excitation step. The observed spectra and angular distributions for all the isotopes are consistent with such a model. Observed mean velocities are compared to those predicted by a liquid-drop theory of fission. It is concluded that products in the mass-90-to-140 range are produced primarily by a conventional fission mechanism. However, some contribution of a spallationlike process appears necessary to account for low-velocity fragments in the case of the neutron-deficient products (particularly ^{131}Ba). (auth)

53199 LEVELS OF ^{130}Xe POPULATED IN β DECAY OF ^{130}I AND ^{130}Cs. Fessler, Theodore E. (Lewis Research Center, Cleveland); Julian, Glenn M.; Jha, S. Phys. Rev., 174: 1472-8 (Oct. 20, 1968).

Gamma rays emitted in the β decay of 5^- ^{130}I and 1^+ ^{130}Cs were studied with Ge(Li) and NaI(Tl) spectrometers. 24 transitions were observed in the decay of ^{130}I, and 16 were observed in the decay of ^{130}Cs. From the γ-ray singles spectra and from coincidence studies, the following excited levels of ^{130}Xe were deduced: 536.1 (2^+), 1122.1 (2^+), 1204.5 (4^+), 1785.9, 1793.5, 1800.1, 1808.1, 1943.9 (5^+), 2016.1, 2150.6, 2171.3, 2223.3, 2242.8, 2361.8 (6^+), 2427.0, 2532.3, 2608.6, and 2752.3 keV. No evidence was found for the population of a possible 0^+ "vibrational triplet" member at about twice the energy of the first excited state. (auth)

53200 TRANSITIONAL NUCLEI. II. HIGHER VIBRATIONAL STATES IN NUCLEUS ^{154}Gd. Meyer, R. A. (Univ. of California, Livermore). Phys. Rev., 174: 1478-81(Oct. 20, 1968).

Isotopically separated ^{154}Eu was used in conjunction with sources prepared from neutron irradiation of isotopically separated ^{153}Eu to study the γ-ray spectra and concomitant level structure of ^{154}Gd. Several levels which have been identified as collective levels are found to have two-phonon character. A collective K = 2 vibrational state was proposed at 1531.39 keV and can be described as a coupled ($\beta\gamma$) two-phonon state. Members of the rotational band built on this state were identified at 1531.39 ± 0.07, 1660.94 ± 0.07, and 1790.4 ± 0.3 keV with spin and parity of 2^+, 3^+, and 4^+, respectively. A possible second band at 1292.7 keV was found to possess two (β) phonon characteristics. Evidence is found for the breakdown of the simple E2 selection rules for transitions from higher phonon bands. (auth)

53201 SPONTANEOUS-FISSION DECAY CONSTANT OF ^{238}U. Roberts, J. H. (Northwestern Univ., Evanston, Ill.); Gold, Raymond; Armani, Roland J. Phys. Rev., 174: 1482-4(Oct. 20, 1968).

A precise measurement (approximately 1.6% relative error) of the spontaneous-fission decay constant of ^{238}U was carried out with solid-state track recorders of pre-etched mica. The present experimental result, $\lambda_F = 7.03 \pm 0.11 \times 10^{-17}$ yr^{-1}, is within the quoted experimental error of earlier measurements both by Fleischer and Price, and by Rao and Kuroda. It is in good agreement with the value inferred by Fleischer and Price from a comparison of different dating methods. (auth)

53202 $^{137}Ba(n,\gamma)$ REACTION AND LEVEL STRUCTURE OF ^{138}Ba. Mariscotti, M. A. J.; Gelletly, W.; Moragues, J. A.; Kane, W. R. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1485-93(Oct. 20, 1968).

The γ rays from the $^{137}Ba(n,\gamma)^{138}Ba$ reaction were studied both in singles and coincidence with a 9-cm^3 Ge(Li) detector and a Ge(Li)-NaI combination. Of a total of 91 γ rays, 15 were identified as primary transitions de-exciting the compound nucleus. These data, together with the information obtained from coincidence spectra and from previous studies, establish 18 levels in ^{138}Ba with energies 1435.7 ± 0.2, 1898.7 ± 0.5, 2189.6 ± 0.5, 2217.6 ± 1.0, 2307.7 ± 0.7, 2445.6 ± 0.5, 2582.7 ± 0.4, 2638.8 ± 0.5, 2880.7 ± 0.3, 3051.4 ± 2.0, 3340.0 ± 1.5, 3503.0 ± 2.0, 3643.4 ± 1.5, 3921.7 ± 1.5, 4241.9 ± 2.0, 4280.4 ± 2.0, 4287.5 ± 2.0, and 4360.2 ± 2.0 keV. In addition, six pairs of γ rays whose energies sum to equal the binding energy were found, but the order of the cascades could not be established. The neutron separation energy was found to be 8611.3 ± 0.8 keV. The prominent 5730.4-keV primary γ ray feeds the level at 2880.7 keV, which is identified with the 3^- state seen in inelastic scattering experiments with charged particles. The level decays predominantly by the 1445.0–1435.7-keV γ-ray cascade through the 2^+ first excited state. The relation between states excited in (p,p') and (d,p) reactions and those observed in the present experiment is discussed. (auth)

53203 ALPHA DECAY OF THE ISOMERS OF ^{214}Fr. Torgerson, David F. (McMaster Univ., Hamilton, Can.); Gough,

Richard A.; Macfarlane, Ronald D. Phys. Rev., 174: 1494-9 (Oct. 20, 1968).

Alpha decay from the ground state and an isomeric state of ^{214}Fr was observed. The ground state has a half-life of 5.0 ± 0.2 msec, and the isomeric state, 3.35 ± 0.05 msec, at an excitation energy of 123 keV. A level scheme for ^{210}At based on several α transitions observed is presented. The similarity of the energy levels of ^{206}Bi with those of ^{210}At suggests that the addition of a proton pair to ^{208}Bi does not significantly alter the nature of the particle-hole interactions observed for ^{206}Bi. (auth)

53204 FISSION-FRAGMENT ENERGY-CORRELATION MEASUREMENTS FOR THE THERMAL-NEUTRON FISSION ON ^{233}U. Pleasonton, Frances (Oak Ridge National Lab., Tenn.). Phys. Rev., 174: 1500-8(Oct. 20, 1968).

Experimental results, based on double-energy measurements using solid-state detectors, are given for the thermal-neutron-induced fission of ^{233}U. Detailed mass and energy distributions and mass-versus-energy correlations were obtained from experiments containing 1.1×10^6 events. The average total kinetic energy is found to be 172.0 ± 1.8 MeV. Results are compared with other kinetic experiments and with radiochemical measurements. (auth)

53205 NUCLEAR PROPERTIES AND MAGNETIC HYPERFINE INTERACTION OF ^{189}Os. Persson, B.; Blumberg, H.; Bent, M. (California Inst. of Tech., Pasadena). Contract AT(04-3)-63. Phys. Rev., 174: 1509-12(Oct. 20, 1968).

Moessbauer absorption of the 69.6-keV γ rays from ^{189}Os was studied in various absorbers at 4.2°K. The following quantities were determined: the half-life of the 69.6-keV state, $t_{\frac{1}{2}} \geq 1.8 \pm 0.2$ nsec; the magnetic moment of the 69.6-keV state, $\mu(69.6) (0.988 \pm 0.010)\mu_N$; the mixing ratio of the 69.6-keV transition, $\delta = \langle||E2||\rangle/\langle||M1||\rangle = +0.71 \pm 0.08$; and the hyperfine field at the Os nuclei dilutely dissolved in Fe, $H_{hf} = 1100 \pm 20$ kOe. The results pertaining to the nucleus are compared with calculations in terms of the rotational model. (auth)

53206 RESONANT AND NONRESONANT CAPTURE OF SLOW NEUTRONS IN ^{169}Tm(n,γ)^{170}Tm. Lone, M. A.; Chrien, R. E.; Wasson, O. A.; Beer, M.; Bhat, M. R.; Muether, H. R. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1512-24 (Oct. 20, 1968).

The intensities of radiative transitions following slow-neutron capture in ^{169}Tm(n,γ)^{170}Tm were measured for neutron energies up to ~136 eV. From the determination of the strengths of transitions feeding final states in ^{170}Tm, the partial radiative widths of resonances below 136 eV are determined, and the partial cross sections $\sigma_{\alpha\gamma f}$ below 30 eV are fitted with a simple Breit–Wigner multilevel formula. A direct amplitude is necessary to achieve good fits for several transitions, including that to the ground state. The correlation of the direct amplitude to the strength of the state as observed in (d,p) is investigated. (auth)

53207 COMPARISON OF EXPERIMENT AND THEORY FOR NUCLEAR EXCITATION IN ^{115}In BY THRESHOLD-ENERGY ELECTRONS. Chertok, B. T.; Johnson, W. T. K. (American Univ., Washington, D. C.). Phys. Rev., 174: 1525-34(Oct. 20, 1968).

The Duke inelastic-electron-scattering program provides a major step in obtaining spin-parity assignments and mixing ratios for nuclear energy levels from threshold-energy electron scattering which populates an isomer. A detailed account of the Duke distorted-wave Born-approximation calculation for threshold-energy electrons is given, and the contribution and Coulomb distortion of the partial waves for M1 and E2 transitions is quantitatively presented. The finite tip observed in threshold electroexcitation is quantitatively accounted for by Coulomb distortion of s- and d-electron waves in the M1 and E2 transitions, respectively. A detailed comparison is made between experiment and theory for the the 1.078- and 1.450-MeV states of ^{115}In, replacing earlier semiquantitative comparisons which used plane-wave Born-approximation calculations that resulted in factors of 2 to 5 disagreement for 1 to 2 MeV electrons. The agreement between the electron excitation functions for isomer population for the 1.078- and 1.450-MeV states and the Duke calculation is well within the ±35% experimental errors. M1/E2 mixing ratios are extracted from the comparison. The 1.078- and 1.450-MeV states of ^{115}In are both $^7/_2^+$ with M1/E2 mixing ratios, $a = \Gamma_{\theta E2}/\Gamma_{\theta M1}$, given by $a = 0.7 \pm 0.3$ and ≤ 0.3, respectively. The mixing ratios are from photon self-absorption and Coulomb-excitation measurements of the same transitions, and corroborate the electron-scattering results. In this regard a search for the 1.078-MeV γ ray following β^- decay of ^{115m}Cd using a Ge(Li) Duode spectrometer yielded a null result, log ft > 11.5 for the β^- transition. With the $^7/_2^+$ assignments made in this work, the coexistence of spherical and rotational bands in ^{115}In is discussed. (auth)

53208 TOTAL INTERNAL CONVERSION COEFFICIENT OF THE 23.9-keV GROUND-STATE TRANSITION IN ^{119m}Sn. Kostroun, Vaclav O.; Crasemann, Bernd (Univ. of Oregon, Eugene). Phys. Rev., 174: 1535-9(Oct. 20, 1968).

The total internal conversion coefficient of the 23.874-keV transition in ^{119m}Sn is found to be $\alpha = 5.13 \pm 0.15$, on the basis of γ- and x-ray intensity measurements with a high-resolution solid-state x-ray spectrometer. Consequently, the Moessbauer cross section for resonant absorption by ^{119}Sn is $1.40 \pm 0.05 \times 10^{-18}$ cm^2. (auth)

53209 NUCLEAR PAIRING ENERGY OF TRANSITION NUCLEUS ^{240}Pu. Huizenga, J. R. (Univ. of Rochester, N. Y. Argonne National Lab., Ill.); Behkami, A. N.; Meadows, J. W. Jr.; Klema, E. D. Phys. Rev., 174: 1539-44(Oct. 20, 1968).

Fission-fragment angular distributions were measured for the fission of ^{239}Pu induced by monoenergetic neutrons of energies 150, 400, 475, 550, 600, 700, 800, 900, 1000, 1100, 1200, 1350, and 1500 keV (energy resolution, ±25 keV). Theoretical calculations are utilized to determine the parameter K_0^2 at each excitation energy from the observed angular distributions. The values of K_0^2 rise sharply from a value of 5 to 6, for neutron energies less than or equal to 600 keV, to an approximately constant value of 13, for neutron energies in the range 1.3 to 2.0 MeV. The break in the K_0^2 curve occurs at about 2.2 MeV above the fission threshold, and is interpreted as the beginning of two-quasiparticle excitations of the highly deformed transition nucleus ^{240}Pu. This result suggests that the pairing energy gap is increased for large nuclear deformations. (auth)

53210 INTENSITIES AND ANGULAR DISTRIBUTIONS OF GROUND-STATE ROTATIONAL TRANSITIONS EXCITED BY (α,3n) AND (α,4n) REACTIONS. Williamson, C. F.; Ferguson, S. M.; Shepherd, B. J.; Halpern, L. (Univ. of Washington, Seattle). Phys. Rev., 174: 1544-52(Oct. 20, 1968).

Relative intensities measured for rotational transitions in the ground-state bands are reported for residual even-even rare-earth nuclei excited in (α,3n) and (α,4n) reactions. The incident α-particle energy was typically ~40.5 MeV, and the targets were isotopes of Gd, Dy, Er, and Yb. The angular distributions of the rotational radiations were found to be in accord with theoretical expectations. The relative intensities of the lines were, however, inconsistent with the implications of simple statistical models. More angular momentum is apparently carried away by photon transitions connecting higher-lying states than one might expect. Possible reasons for this discrepancy are briefly discussed. (auth)

53211 NOTE ON THE SCATTERING CROSS SECTIONS OF THE ISOTOPES OF DYSPROSIUM. Child, H. R.; Raubenheimer, L. J.; Koehler, W. C.; Moon, R. M. (Oak Ridge National Lab., Tenn.). Phys. Rev., 174: 1553(Oct. 20, 1968).

Neutron diffraction experiments were performed on isotopically enriched specimens of Dy_2O_3 in order to determine the coherent scattering amplitudes of the major isotopic constituents of Dy. The amplitudes for ^{160}Dy, ^{161}Dy, ^{162}Dy, ^{163}Dy, and ^{164}Dy, as measured at 1.08 Å, are presented, together with coherent scattering cross sections and total cross sections. (D.C.W.)

53212 (p,n) AND (p,pxn) REACTIONS IN ^{127}I. Narang, V. P.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 46: 3171-6 (Oct. 15, 1968).

Absolute values of the cross sections of (p,n), (p,pn), (p,p2n), and (p,p3n) reactions in ^{127}I were measured by radiochemical methods for incident proton of energies up to 80 MeV. The initial portion of the excitation function for the (p,n) reaction is characteristic of the compound-nucleus mechanism, but evidence for direct interaction is present at higher energies. Above 50 MeV, cross sections are close to the predictions of Monte Carlo calculations based on the cascade-evaporation model. This is particularly true in the case of the (p,pn) and (p,p2n) reactions. (auth) (CANADA)

53213 LIFETIME OF THE 267-keV STATE IN ^{93}Zr. Prestwich, W. V.; Arad, B.; Boulter, J.; Fritze, K. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 46: 2321-4(Oct. 15, 1968).

The lifetime of the 267-keV state in ^{93}Zr was determined by delayed coincidence studies using scintillation detectors. The value measured is $T_{\frac{1}{2}} = 1.45 \pm 0.05 \times 10^{-9}$ s. The B(E2) value for this transition is approximately equal to that for the one-phonon ground-state transitions in ^{92}Zr and ^{94}Zr. This result indicates that the 267-keV level is probably a member of a core-excitation multiplet. (auth) (CANADA)

53214 MOESSBAUER STUDY OF THE ELECTROMAGNETIC PROPERTIES OF THE 69.6-keV LEVEL IN ^{189}Os. Kucheida, D.; Wagner, F.; Kaindl, G.; Kienle, P. (Technische Hochschule, Munich). Z. Phys., 216: 346-54(1968).

The 69.6-keV level with spin $^5/_2^-$ in ^{189}Os was investigated by the recoilless resonance absorption technique. Its magnetic moment was found to be $\mu(^5/_2) = (0.977 \pm 0.014)\mu_N$. From the measured ratio of the excited and ground-state electric quadrupole moments, $Q(^5/_2)/Q(^3/_2) = -0.79 \pm 0.09$, the excited-state quadrupole moment $Q(^5/_2) = -(0.72 \pm 0.11)$b could be derived. The E2/M1 mixing parameter of the 69.6-keV ground-state transition was found to be $\delta = +0.69 \pm 0.10$. The results are interpreted in terms of two low-energy rotational bands with strong Coriolis mixing. (auth)

53215 HALF-LIFE MEASUREMENTS OF INTRINSIC STATES IN DEFORMED ODD-MASS NUCLEI. Loebner, K. E. G. (Instituut voor Kernphysisch Onderzoek, Amsterdam. Technical Univ., Munich). Z. Phys., 216: 372-97(1968).

The half-lives of the 86.5-keV state in ^{155}Gd, the 191.4-keV state in ^{169}Yb, and the 122.39-keV state in ^{171}Yb were measured by delayed coincidence with a time-to-amplitude converter. The transition probabilities for the states were determined. The time-to-amplitude converter was tested by measuring the well-known half-lives of ^{181}Ta and ^{203}Tl. (D.C.W.)

53216 DISTRIBUTION OF MASS IN THE FISSION OF ^{209}Bi, ^{232}Tr, ^{233}U, AND ^{242}Pu. Ganapathy, Ramachandran. Fayetteville, Ark., Univ. of Arkansas, 1968. 85p.

Thesis.

Bismuth was found to undergo fission with 14.8-MeV neutrons. The fission cross section at this neutron energy was found to be $3.5 \pm 1.0 \times 10^{-32}$ cm^2. Radiochemical measurements made of the fission yields of ten mass chains from the fission of ^{232}Th by 14.8-MeV neutrons indicated the presence of a third peak in the mass-yield curve. The results are A = 99, 2.00 ± 0.10%, 101, 1.60 ± 0.20%; 102, 0.70 ± 0.15%; 103, 0.75 ± 0.13%; 105, 0.92 ± 0.10; 106, 1.07 ± 0.10%; 109, 1.10 ± 0.10%; 111, 1.50 ± 0.15%; 113, 1.20 ± 0.10%; 115, 1.24 ± 0.20%. Fission yields of fifteen mass chains were measured from the fission of ^{233}U by thermal neutrons using improved radiochemical techniques with emphasis placed on the fine structure region. A = 131–135. The results are A = 89, 5.50 ± 0.30%; 90, 6.40 ± 0.30%; 95, 6.02 ± 0.30%; 99, 4.8%; 103, 1.75 ± 0.10%; 106, 0.23 ± 0.02%; 111, 0.02 ± 0.002%; 131, 3.08 ± 0.20%; 132, 4.10 ± 0.40%; 133, 6.50 ± 0.65%; 134, 6.10 ± 0.30%; 135, 4.55 ± 0.45%; 140, 5.90 ± 0.30%; 141, 6.10 ± 0.40%; 144, 4.54 ± 0.30%. The results indicate the absence of any pronounced peak in the fine structure region. Cumulative fission yields for the mass chains A = 131 to 135 were measured radiochemically by isolating the iodine isotopes resulting from the spontaneous fission of ^{242}Pu with the following results: A = 131, 1.0% (reference standard); 132, 5.0 ± 0.7%; 133, 5.3 ± 0.7%; 134, 7.1 ± 1.0%; 135, 5.3 ± 0.8%. The general pattern of the mass-yield distribution from the ^{242}Pu spontaneous fission is similar to that from the thermal neutron-induced fission of ^{241}Pu, except for the fact that the relative yields at mass numbers 132 and 134 appear to be slightly higher in the former. The mass-yield distributions of the "excess" heavy xenon isotopes observed in some meteorites show a remarkable resemblance to the shapes of the mass-yield curves from the spontaneous fission of ^{238}U and ^{242}Pu. These results suggest that the excess heavy xenon isotopes found in meteorites are the decay products of the "extinct" nuclide ^{244}Pu. (Diss. Abstr.)

53217 RADIATION EMITTED DURING THE α DECAY OF ^{224}Ac. Leang, Chin Fan; Bastin, Genevieve; Walen, Robert J. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). Compt. Rend., Ser. A and B, 267: 303-5 (July 22, 1968). (In French).

The decay ^{224}Ac → ^{220}Fr was studied by magnetic spectrography (simple α spectrum) and by α-γ coincidences with multiparametric registration. (tr-auth)

53218 CONTRIBUTION TO THE STUDY OF THE LEVEL SCHEME OF ^{234}U. Godart, Jacques; Gizon, Andree; Boutet, Jean; Henck, Roland (Institut des Sciences Nucleaires, Grenoble, France. Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. A and B, 267: 300-2(July 22, 1968). (In French).

The energies and intensity of the γ transitions accompanying the decay ^{234}Pa (UZ, $T_{\frac{1}{2}}$ = 6.7 hr) → ^{234}U were determined with the aid of Ge(Li) detectors. The results are tabulated. (tr-auth)

Nuclear Theory

Refer also to abstracts 52853, 52913, 52959, 52993, 52994, 53037, 53078, 53085, 53089, 53106, 53107, 53114, 53115, 53130, 53131, 53134, 53135, 53147, 53155, 53166, 53169, 53176, and 53185.

53219 (CEA-R-3574) NUCLEON TRANSFER REACTIONS IN DWBA. Giraud, Bertrand; Picard, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug. 1968. 54p. (In French). Dep.

The DWBA for one-nucleon transfer reactions is described as simply and completely as possible to show the possibilities and limits of this method. The extraction of spectroscopic factors is described. (auth)

53220 (INR-P-920) EQUILIBRIUM DEFORMATIONS OF THE GROUND AND EXCITED STATES IN NUCLEI. Szymanski, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 24p. (CONF-680702-5). Dep.

From International Symposium on Nuclear Structure, Dubna, USSR.

The deformations of atomic nuclei, i.e., the deviations of their shape from the spherical shape, are discussed. An attempt is made to understand the origin and nature of deformation. Various aspects of the problem such as axial symmetry, higher multipole (hexadecapole) components, deformations of the excited states, potential and kinetic energy in the fission process, etc., are discussed. (auth)

53221 (NRL-6729) TOPICS IN ELECTRON SCATTERING AND NUCLEAR MODELS. Notes on Lectures Given at NRL in the Fall of 1966. Ueberall, H. (Naval Research Lab., Washington, D. C.). Apr. 3, 1968. 78p.

A review is presented of the basic theory of electron scattering from nuclei and of photonuclear processes, as well as a discussion of the analysis of electron scattering experiments. This includes cross sections in Born approximation, elastic scattering from nuclei for the study of nuclear moments, and continuum scattering. Particular attention is given to inelastic electron scattering with excitation of nuclear levels, both below and in the giant resonance region. Various theoretical models are discussed that describe excitations of nuclear states. (auth)

53222 (ORNL-TM-2342) FITS TO SINGLE PARTICLE WAVE FUNCTIONS USING WOODS–SAXON EIGENFUNCTIONS: THE CODE LINDA. Chwieroth, F. S. (Oak Ridge National Lab., Tenn.). Sept. 4, 1968. Contract W-7405-eng-26. 15p. Dep. CFSTI.

A FORTRAN code has been written for the IBM-360 which optimizes the agreement between a set of input single particle wave functions and/or binding energies and a corresponding set computed using a Woods–Saxon potential well by varying the parameters of the potential well. A number of options allow this to be done in various ways. Spin-orbit coupling and non-locality effects may be included. (auth)

53223 A SPACE SCALAR APPROXIMATION TO THE PARTICLE–HOLE INTERACTION IN THE 2s-1d SHELL. Hecht, K. T.; Ellis, P. J.; Engeland, T. (Univ. of Michigan, Ann Arbor). Phys. Lett., 27B: 479-82(Sept. 16, 1968).

It is shown that the diagonal matrix elements of the Gillet particle-hole interaction can be well reproduced by retaining only those terms which are space scalars. (auth)

53224 POSSIBILITY OF OBSERVING ZERO SOUND IN NUCLEI BY RADIATIVE PION CAPTURE. Akhiezer, A. I.; Akhiezer, I. A. (Kharkov State Univ.). JETP Lett. (USSR) (Engl. Transl.), 8: 24-6(July 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 42-5(July 5, 1968).

The interactions of slow pions with nuclei are investigated from the standpoint of the information that can be obtained on zero sound (density waves, spin waves, isospin waves, and coupled spin-isospin waves) in nuclear matter. The cross sections for the different interactions are expressed in terms of nuclear matter correlators that are defined using the Fermi liquid model. (J.W.R.)

53225 AN APPROXIMATION FOR ROTATION-PROJECTED EXPECTATION VALUES OF THE ENERGY FOR DEFORMED NUCLEI AND A DERIVATION OF THE CRANKING VARIATIONAL EQUATION. Kamlah, A. (Technische Hochschule, Munich). Z. Phys., 216: 52-64(1968).

An approximation is given for the expectation value of the Hamiltonian with functions: $|\phi_{jm}\rangle = \Sigma_k g_{jk}^* \int D_{mk}^{j*}(\Omega) D(\Omega) d\Omega |\varphi\rangle$, where $|\varphi\rangle$ is a HFB wave function of a deformed nucleus. This is achieved by expanding the overlap function of the energy $\langle\varphi|HD(\Omega)|\varphi\rangle$ in derivatives of the overlap function of the norm $\langle\varphi|D(\Omega)|\varphi\rangle$. The cranking equations for even nuclei are yielded by varying the approximate energy.

53226 NUCLEAR STRUCTURE AND MODERN RESEARCH. Weisskopf, Victor F. Phys. Bl., 24: 289-97(July 1968). (In German).

Research on the structure of matter in the last decade is distinguished by three stages: the study of the electron shell of the atom, then the study of the nuclear structure, and finally the

study of the nucleon. The research on the first two stages is briefly outlined, and the third stage is discussed in more detail. The principal questions to be determined in the study of nuclear structure are summarized. Two different viewpoints in the formulation of experiments on nucleon structure are discussed. Applications of nuclear physics and astrophysics to the study of nucleon structure are considered. (tr-auth)

53227 SCATTERING AND BOUND-STATE POTENTIALS OF COMPOSITE PARTICLES IN DWBA CALCULATIONS FOR THE Mg REGION. Duhm, H. H. (Univ. of California, Berkeley. Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A118: 563-76(1968).

Optical-model potentials appropriate for the description of scattering and transfer reactions in the Mg region were investigated. The scattering potentials were obtained for p,d, ^{3}He, and α particles elastically scattered by ^{24}Mg(E_p = 30.5 MeV; E_d = 40.MeV; $E_{^3He}$ = 35.3 and 47.5 MeV; E_α = 50.1, 65.7, 81, and 119.7 MeV). The attempt is made to identify the most "reasonable" sets of potential families for the composite particles by comparison with bound-state potential well depths for the corresponding cluster wave functions of the (^{24}Mg + composite particle) system. This method selects relatively shallow ^{3}He and α potentials. However, for nuclear transfer reactions, e.g., the ^{24}Mg(d,^{3}He)^{23}Na and ^{26}Mg(p,t)^{24}Mg reactions, the shallow ^{3}He potential does not yield good DWBA fits, whereas the next deeper potential family gives much better fits. The successful use of the deeper ^{3}He potential may be explained from the approximations in deriving the DWBA transition amplitude. These approximations suggest potential depths according to a sum-rule criterion in which the real part of the potential of the heavier particle equals the sum of the potential for the lighter projectile plus the bound-state potential of the transferred particle. The applicability of this potential sum rule was tested for the ^{24}Mg(d,^{3}He) ^{23}Na and ^{26}Mg(p,t)^{24}Mg reactions. The fits for constructed potentials according to the sum rule were as good as those obtained from the best possible choice of measured parameters. (auth)

53228 GROUND-STATE AND SADDLE-POINT PROPERTIES OF HEAVY NUCLEI FOR A DYNAMIC FISSION MODEL. Hasse, Rainer W. (Univ., Wuerzburg, Ger.). Nucl. Phys., A118: 577-91(1968).

Ground states and saddle points of the heavy elements thorium to fermium are calculated with a modified liquid-drop formula including curvature and shell-energy corrections. Intrinsic quadrupole moments and barrier energies are compared with experimental data. Relative moments of inertia at the saddle point are computed. Three degrees of freedom, e.g., elongation, asymmetry and constriction, which are at the saddle point equivalent to the three normal modes of oscillation, e.g., fission, asymmetry and vibration are allowed. The normal stiffnesses and normal masses of these modes are presented. Fission-barrier curvatures are compared with those achieved by experiments. Statistics of the initial coordinates in the vicinity of the saddle are performed for low-energy fission of heavy elements. (auth)

53229 ELASTIC SCATTERING OF CHARGED PARTICLES FROM POLARIZED QUADRUPOLE MOMENTS. Smilansky, U. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A118: 529-37(1968).

The effect of the quadrupole moment on the elastic scattering of charged particles from polarized targets is discussed. Both the DWBA and the WKB approximations in three dimensions are used in the evaluation of the first-order correction to the backward scattering cross section. A closed expression is obtained from the WKB treatment, and the range of its applicability is determined by a comparison to the DWBA results. (auth)

53230 THE CHARGED-PARTICLE LEVINSON THEOREM AND THE QUANTUM DEFECT. Swan, Peter (Univ. Laval, Quebec). Nucl. Phys., A119: 40-52(1968).

Levinson's theorem is considered for the single-channel scattering of charged particles by a short-range central potential U(r) with finite first and second moment integrals. For a repulsive Coulomb field, the Levinson relation for the phase shift $\eta_l(k)$ for $l \geq 1$ is $\eta_l(0) - \eta_l(\infty) = n_l\pi$, where $\eta_l(\infty) = 0$ and n_l is the number of composite bound states with energies $E_n \leq 0$. For $l = 0$, n_0 counts only the composite bound states with energy $E_n < 0$, but if a resonant state at $E = 0$ is present, the relation is modified to $\eta_0(0) - \eta_0(\infty) = (n_0 + \frac{1}{2})\pi$. An attractive Coulomb field has an infinite number of bound-state energies $E_n = -\hbar^2\beta^2/8\mu n^2$. Switching on the short-range potential field U(r) displaces these levels to $E_n' = -\hbar^2\beta^2/8\mu n'^2$, where $n' = n - \mu_l(n)$ and $\mu_l(n)$ is called the quantum defect. In terms of $\mu_l(k^2)$, the Levinson theorem for $l \geq 0$ becomes $\eta_l(0) - \eta_l(\infty) = \mu_l(0)\pi$, with $\eta_l(\infty) = 0$ and $\mu_l(0)$ in general an irrational number. The quantum defect $\mu_l(0)$ is found most simply via solution of the zero-energy wave equation. Alternatively, a first order, non-linear differential equation for a phase function $\eta_l(k,r)$ gives the zero-energy phase shift $\eta_l(0,\infty) = \eta_l(0)$ via numerical integration. This determines n_l for repulsive and $\mu_l(0)$ for attractive Coulomb fields. (auth)

53231 ON THE DESCRIPTION OF FERMION SYSTEMS IN BOSON REPRESENTATIONS. II. FURTHER DISCUSSION OF THE DEGENERATE MODEL AND THE y^0 DEGREE OF FREEDOM. Soerensen, Bent (Univ. of Copenhagen). Nucl. Phys., A119: 65-78(1968).

The boson expansions of fermion pair operators proposed earlier are for the case of seniority-zero pairs in one degenerate j-shell given in a closed form. It is shown, for the case of pairing interaction, that the boson treatment gives the exact solutions. This provides an unambiguous interpretation of a parameter denoted y^0, which is left undetermined by the boson method. The role played by y^0 in realistic calculations is further discussed including now quadrupole residual interaction in the model. (auth)

53232 PAIRING AND DEFORMATION IN A SOLVABLE MODEL AND THE VALIDITY OF DIFFERENT APPROXIMATION METHODS. Schuette, D.; Bleuler, K. (Univ. of Bonn). Nucl. Phys., A119: 221-32(1968).

An exactly solvable nuclear model is considered in order to test the validity of various well-known approximation methods. The model Hamiltonian is built on two shells and contains two essentially different interactions (pairing and monopole coupling); it exhibits typical features of realistic Hamiltonians of heavier nuclei and leads in addition to an understanding of specific nuclear properties in the transitional regions. The energies and the expansion coefficients of the lowest states are determined as functions of the characteristic parameters of the model, i.e., the particle number and the strengths of the interactions. The calculations are based on the generalized quasi-spin method. The Hamiltonian H is expressed by a set of operators which define the Lie algebra of O_6; the matrix elements of H for the relevant representations of this algebra are obtained by means of an algebraic computer program which, in addition, takes care of the remaining diagonalization. The numerical results thus obtained are represented graphically in several diagrams. The characteristic dependences of the relevant quantities on the parameters show the invariance of the "pairing solution" (sharp seniority) with respect to the addition of the second interaction within a well-defined interval of relative strength (pairing region) and prove the existence of a transitional region with strong variations of nuclear properties (characteristic admixtures of higher seniorities) to be followed by a "deformed" region with extremely low-lying levels. In addition, typical "vibrational levels" within the pairing region and their continuous transition to the "rotational states" of the deformed domain are obtained. The validity of the Frank-Condon principle is illustrated by the characteristic behavior of excited states in the transitional region. (auth)

53233 IRREDUCIBLE REPRESENTATIONS OF THE FIVE-DIMENSIONAL ROTATION GROUP. I. Kemmer, N. (Univ. of Edinburgh); Pursey, D. L.; Williams, S. A. J. Math. Phys. (N. Y.), 9: 1224-30(Aug. 1968). (IS-1652).

Explicit matrix elements are found for the generators of the group R(5) in an arbitrary irreducible representation using the "natural basis" in which the representation of R(5) is fully reduced with respect to the subgroup $R(4) = SU(2) \otimes SU(2)$. The technique used is based on the well-known Racah algebra. The dimension formula is derived and the invariants are found. A family of identities is established which relates various polynomials of degree four in the generators and which holds in any representation of the group. (auth)

53234 IRREDUCIBLE REPRESENTATIONS OF THE FIVE-DIMENSIONAL ROTATION GROUP. II. Williams, S. A.; Pursey, D. L. (Ames Lab., Iowa). J. Math. Phys. (N. Y.), 9: 1230-40 (Aug. 1968). (IS-1677).

A systematic study is made of the relation between the generators of R(5) expressed in the "natural basis," as discussed in I [J. Math. Phys. 9, 1224 (1968)], and the same generators in the "physical basis" in which representations of R(5) are fully reduced with respect to the physical three-dimensional rotation group. In this paper, attention is confined to the traceless symmetric tensors of R(5) which are the representations appropriate to the discussion of quadrupole vibrations of the nuclear surface. For these representations, one quantum number in addition to the angular momentum and its projection is required to specify a state within a representation. The required extra label is found through the definition of "intrinsic states" in the natural basis, and a com-

plete set of states in the physical basis is projected out of these intrinsic states by integrations over the physical rotation group manifold. Members of this set of physical states are not orthonormal; however, the overlap integrals are presented in two simple algebraic forms convenient for computer programming. The construction of the explicit representation matrices for the generators of R(5) is completed by giving the reduced matrix elements of the octopole generator between physical states in terms of the overlap integrals. (auth)

53235 MOLECULE-LIKE STRUCTURE IN ATOMIC NUCLEI OF ^{16}O AND ^{20}Ne. Horiuchi, Hisashi; Ikeda, Kiyomi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 277-87(Aug. 1968).

The molecular aspect is developed from the studies of the rotational bands in light 4n-nuclei. It is shown that two rotational bands with $K = 0^+$ and 0^- such as in ^{16}O and ^{20}Ne can be unified as the twins with the same molecule-like structure of an alpha particle plus a residual core nucleus. The gap energy between two bands, from a molecular viewpoint, is thought to be the splitting energy of an inversion doublet. The characteristics of the central barrier through which one configuration penetrates into its reflected configuration can be deduced from the properties of the light 4n-nuclei. Experimental splitting energies can be fitted with the reasonable parameters for the central barrier. Some further remarks on the properties of the molecule-like structure can be made. (auth)

53236 NEUTRON CAPTURE. Bird, J. R. (AAEC Research Establishment, Lucas Heights, New South Wales). Aust. Phys., 5: 111-15(Aug. 1968).

The neutron capture process and experimental methods for its study are discussed. Neutron capture studies being carried out by Australian universities and the Australian Atomic Energy Commission are outlined. (J.W.R.)

53237 SHAPE OF THE NUCLEAR SYMMETRY POTENTIAL. Zimanyi, J. (Central Research Inst. for Physics, Budapest); Gyarmati, B. Phys. Rev., 174: 1112-14(Oct. 20, 1968).

The form factor of the real symmetry potential is explicitly calculated from a simple microscopic model of isobaric analog resonances. Numerical results are presented for ^{48}Ca, ^{132}Sn, and ^{208}Pb. For ^{48}Ca, the symmetry potential turns out to be of the surface type, while for ^{132}Sn and ^{208}Pb it is of the volume type. The magnitude depends only on the strength of the n-p interaction. (auth)

53238 CALCULATION OF THE LIFETIME OF A METASTABLE SYSTEM. Celenza, L.; Tobocman, W. (Case Western Reserve Univ., Cleveland). Phys. Rev., 174: 1115-19(Oct. 20, 1968).

In the context of a soluble model, two approximate methods of calculating the lifetime of a metastable state are compared with the "exact" method. The exact method involves the usual relation $T = 2\hbar\Gamma^{-1}$ between the lifetime T of a metastable state and the displacement $\Gamma/2$ of the resonance pole of the S matrix from the real energy axis. This result is contrasted with those obtained by using Fermi's "golden rule" and F. T. Smith's time-delay method. While the "golden rule" method involves a first-order determination of the transition amplitude connecting the approximate bound state to the final approximate continuum state, Smith's method is nonperturbative and utilizes the S matrix directly. (auth)

53239 SEPARABLE t MATRICES AND HARD-CORE POTENTIALS. Fuda, Michael G. (State Univ. of New York, Buffalo). Phys. Rev., 174: 1134-5(Oct. 20, 1968).

A separable expansion for the two-body t matrix arising from a hard-core potential is developed using a method suggested by Weinberg. This expansion reduces the Faddeev equations to a set of coupled, one-dimensional integral equations. The convergence of the expansion to the exact result is demonstrated, and the rate of convergence is illustrated. (auth)

53240 LOW-ENERGY METHOD IN HIGH-ENERGY SCATTERINGS. Hahn, Yukap (Univ. of Connecticut, Storrs). Phys. Rev., 174: 1135-9(Oct. 20, 1968).

The impact-parameter representation of the high-energy scattering amplitude is derived in which the effect of the reduced kinetic-energy operator for the slowly varying wave amplitude in the potential scattering is estimated variationally. An associated zero-energy scattering problem can be estimated using the local minimum property. The method is extended to high-energy composite-system scatterings in which all the inelastic channel effect can be variationally included. (auth)

53241 MANY-BODY THEORY OF NUCLEAR REACTIONS. Hahn, Yukap (Univ. of Connecticut, Storrs). Phys. Rev., 174: 1168-78(Oct. 20, 1968).

The localization of composite projectiles in the many-body theory of nuclear reactions is studied within the single-particle shell model with configuration mixing. Difficulties are pointed out in extending the existing theory of nucleon–heavy nucleus scattering to more general reaction processes, and it is shown that an improved treatment of the collective variables corresponding to the center-of-mass motion of clusters is necessary in order to generalize the theory. Multiple, deformed single-particle (shell-model) potentials, modified to incorporate the center-of-mass motion, are introduced to spatially localize the composite particles in the continuum. The total center-of-mass motion gives rise to a physically trivial degeneracy, while the relative motion of clusters is the very scattering process being solved. Double sets of redundant variables are introduced to describe the reactions involving two-cluster channels, and the correct scattering functions are obtained by the double-projection method of Peierls and Thouless. (auth)

53242 SINGLE SEPARABLE POTENTIAL WITH ATTRACTION AND REPULSION. Tabakin, Frank (Univ. of Pittsburgh). Phys. Rev., 174: 1208-12(Oct. 20, 1968).

It is shown that a single separable potential can give both an attraction and a repulsion. This property is used to construct an interaction that fits the two-nucleon, S-wave phase shifts. For this potential, the important effects of the strong short-range repulsion can be included directly in existing three-body programs. (auth)

53243 INTERMEDIATE STRUCTURE AND PARTICLE-HOLE STATES IN NUCLEAR REACTIONS. Payne, G. L. (Univ. of California, San Diego, La Jolla. Univ. of Maryland, College Park). Phys. Rev., 174: 1227-46(Oct. 20, 1968).

The effects of nuclear two-particle–one-hole (2p-1h) states on the energy-averaged cross section are studied to see when they cause observable fluctuations. This is done by using the self-consistent perturbation methods of Brueckner to derive an optical potential for the elastic scattering of neutrons. It is then shown that for the case where the interaction between different 2p-1h states can be neglected and the coupling to more complicated configurations is small, the scattering matrix can be approximated to second order in the interaction by a slowly varying background term plus a resonant term. The width of this resonant term is shown to be equal to the escape width plus a spreading width caused by the coupling to the more complicated configurations. These widths are calculated for a number of 2p-1h configurations in various spherical nuclei in order to determine when the isolated resonance condition ($\Gamma < D$) is satisfied. It is found that for the light and doubly magic nuclei, individual resonances of this particular type should be observable only for incident neutron energies below 2 to 3 MeV. At higher energies, the density of 2p-1h states and the widths are too large for the occurrence of individual resonances. In the heavier nuclei ($A \gtrsim 60$) with partially filled shells, the 2p-1h states are broadened so much by the decay to the more complicated states that individual 2p-1h states cause no observable effects. The possibility of other types of states causing observable fluctuations is not considered. (auth)

53244 BRUECKNER THEORY IN AN OSCILLATOR BASIS. I. THE METHOD OF REFERENCE BETHE–GOLDSTONE EQUATIONS AND COMPARISON OF THE YALE, REID (HARD-CORE), AND HAMADA–JOHNSTON INTERACTIONS. Becker, Richard L.; MacKellar, Alan D.; Morris, B. M. (Oak Ridge National Lab., Tenn.). Phys. Rev., 174: 1264-90(Oct. 20, 1968).

Arguments are given for preferring discrete localized excited single-particle states to plane waves in Brueckner theory for finite nuclei. Short-range internuclear repulsion requires transforming pair states to relative and center-of-mass coordinates, in which only constant and harmonic potentials separate. This series of papers develops a form of Brueckner theory in which single-particle states are expanded in harmonic-oscillator functions. This paper is limited to the single-oscillator-configuration (SOC) approximation. The reaction matrix is obtained in two steps: A reference matrix, involving the potential $V^R(r_1) = -C + \frac{1}{2}m\omega^2 r_1^2$ and Eden and Emery's rather good approximate Pauli operator, is obtained by solving radial Bethe–Goldstone equations. The off-diagonal elements of the tensor interaction are treated exactly in coupled equations. Second, essentially the exact SOC matrix is calculated; by making the Pauli and spectral corrections on the reference two-body rather than the relative matrix elements the exact SOC Pauli operator can be used, and energies of low-lying excited states can be varied (e.g., to satisfy self-consistency conditions). The Pauli corrections are much smaller than when the Pauli effect is omitted entirely in the reference matrix. By proper choice of C, the spectral corrections also may be reduced. Three interactions with hard cores are compared under the same conditions. The gap between occupied and excited states is greater than

$\frac{3}{2}$ the normal oscillator spacing $\hbar\omega$. Occupied-state energies and pair-creation matrix elements of V^R are made nearly self-consistent. The three interactions are practically equivalent, as demonstrated in a calculation of the energetics of ^{16}O. The most advantageous choice of excited-state spectrum remains the outstanding uncertainty, probably requiring careful evaluation of the Bethe three-body cluster for finite nuclei. (auth)

53245 NUCLEAR FORCES. Ingber, Lester. (Univ. of California, San Diego, La Jolla). Phys. Rev., 174: 1250-63 (Oct. 20, 1968).

One-meson-exchange Feynman diagrams are nonrelativistically reduced and unitarized via Schroedinger's equation. Properties of nucleon-nucleon scattering are calculated at incident laboratory energies of 25 to 310 MeV. Bound-state properties of the deuteron and of nuclear matter are also calculated. Mesons included are the π, η, σ, ρ, ω, and φ. Very good overall agreement with the experimental data is obtained. Important features of this "potential" include its momentum dependence, properly treated, and the contribution of the σ "meson," which qualitatively changes the central/tensor force ratio from that of previous phenomenological potentials. (auth)

53246 MOMENT OF INERTIA IN LIGHT NUCLEI. Das Gupta, S.; Van Ginneken, A. (McGill Univ., Montreal). Phys. Rev., 174: 1316-19(Oct. 20, 1968).

Moments of inertia for the ground-state bands of a few light nuclei are calculated using exact cranking, the Skyrme–Levinson variational method, approximate projection, and the formulas of Inglis and of Thouless and Valatin. It is found that the first three methods yield almost identical values which are rather different from the last two. In addition, the first three methods satisfy the Kelson test very well, whereas the last two do not. This provides further confirmation that the first three methods give dependable moments of inertia. Reasons for the agreement of exact cranking, the Skyrme–Levinson method, and the approximate projection method are given. (auth)

53247 STATE DEPENDENCE OF COULOMB INTERACTION IN NUCLEI. Bertsch, George F. (Princeton Univ., N. J.). Phys. Rev., 174: 1313-15(Oct. 20, 1968).

The Coulomb energies of valence particles in ^{18}Ne and ^{42}Ti are calculated using realistic two-particle wave functions. The extra correlation in the configuration-mixed wave functions increases the Coulomb interaction by ~150 keV for the 0^+ state, and ~50 keV for the 2^+. This large effect brings the theoretical binding-energy differences of the mass-18 and mass-42 isospin triplets into agreement with experiment, but yields an average interaction larger than required by the binding-energy systematics of heavier nuclei. (auth)

53248 REALISTIC N–N ONE-BOSON-EXCHANGE POTENTIALS. Ueda, T.; Green, A. E. S. (Univ. of Florida, Gainesville). Phys. Rev., 174: 1304-12(Oct. 20, 1968).

Three models which reproduce all of the most recent nucleon-nucleon data almost quantitatively are developed. These models use the regularization technique in a fashion which is interpreted in terms of form factors for the nucleon-meson vertices. Two of the models incorporate recently established heavy scalar mesons: the π_V (1016 MeV) and the η_V (1070 MeV). The third model incorporates, as in prior work, mesons with the same mass as the vector mesons. The fits to all the nucleon-nucleon data are examined, and the results are compared with other models. It appears that one can incorporate very heavy scalar mesons and describe the nucleon-nucleon force quite precisely. Certain ambiguities in the experimental data and phenomenological phase shifts are discussed. (auth)

53249 STRUCTURE OF THE SELF-CONSISTENT SOLUTIONS FOR EVEN–EVEN NUCLEI IN THE 2p-1f SHELL. Parikh, J. C. (Univ. of Rochester, N. Y.); Svenne, J. P. Phys. Rev., 174: 1343-56(Oct. 20, 1968).

The results of Hartree–Fock calculations on even-even nuclei in the 2p-1 f shell are presented. The method of Kelson and Levinson is used, whereby ^{40}Ca is taken as an inert core and the Hartree–Fock variation is done only on the particles outside ^{40}Ca moving in the 2p-1 f shell. Binding energies, 2^λ-pole moments, and single-particle structure of a number of nuclei are calculated. The total pickup strengths for neutrons and protons are calculated. It is found that, as in the 2s-1d shell, tht SU_3 scheme is quite good and only weakly broken by the spin-orbit force. However, the gap between occupied and unoccupied levels is smaller by a factor of 3 than in the s-d shell. Therefore, particle-hole excitations and correlation effects have a much stronger influence on the low-energy structure of the p-f–shell nuclei. (auth)

53250 BINDING ENERGY OF NUCLEAR MATTER BY THE HOLE LINE EXPANSION METHOD. I. Akaishi, Yoshinori; Bando, Hiroharu; Kuriyama, Atsushi; Nagata, Sinobu (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 40: 288-300(Aug. 1968).

The theory of nuclear matter is modified in such a way that the concept of the one-body potential is given up for the off-energy shell and kept only for the on-energy shell. In this method such complications as many-particle excitations which couple one by one through the off-energy shell potential no longer occur and all higher-order terms are treated with a given number of hole lines as a whole. Following this method, the two-body and three-body contributions to the binding energy are calculated for the hard core and soft core potentials. The two-body contributions are about 10 MeV for the soft core and 5 to 7 MeV for the hard core potentials. The three-body contribution is found to be sensitive to the behavior of the two-body correlation function in the outer healing region. The three-body contributions are repulsive and about 0.5 MeV at $r_0 = 1.1$ fm for the soft core and 0.8 MeV at $r_0 = 1.6$ fm for the H–J potential. (auth)

53251 SHAPE ISOMERS. Wilkinson, Denys H. (Oxford Univ.). Comments Nucl. Particle Phys., 11: 146-50(Sept.-Oct. 1968).

Shape isomers are explained in terms of an energy versus deformation curve which contains two minima similar to that for some fissionable nuclei. (J.W.R.)

53252 SHELL MODEL FOR LEAD. Bromley, D. A.; Weneser, J. (Yale Univ., New Haven). Comments Nucl. Particle Phys., 11: 151-61(Sept.-Oct. 1968).

A review of some recent data relating to the lead region is given. It is shown that the validity of the shell model of the nucleus is strongly enhanced by this data. (J.W.R.)

53253 HIGHER-ORDER CORE POLARIZATION CONTRIBUTIONS TO EFFECTIVE INTERACTIONS. Barrett, B. R.; Kirson, M. W. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 27B: 544-8(Sept. 30, 1968).

The perturbation theory calculation of the core-polarization to effective interactions in mass 18 nuclei is carried to higher order, and it is shown that the perturbation series appears to diverge. It is argued, by analogy with nuclear matter results, that all three-body contributions to the core polarization must be treated together. (auth)

53254 THREE-PARTICLE CORRELATIONS IN NUCLEAR MATTER. Fiset, Edmund Oliver. Seattle, Univ. of Washington, 1967. 200p.

Thesis.

A calculation of the effects of three-particle correlations in nuclear matter is described. The approach used is the Martin-Schwinger-Puff Green's function formalism of quantum statistical mechanics. The heirarchy of Green's function equations is terminated by factoring the four-particle Green's function to yield an integral equation for the three-particle Green's function. A three-particle T-matrix is defined and is found to obey an integral equation of the Fadeev form. Consequently heavy reliance is placed on earlier two-particle theories. The energy and density is calculated in terms of the T-matrix. Careful studies of the analytic properties of T and of the two-body t-matrix simplify the energy and density equations considerably so that both are found to consist of the old two-particle result plus an additive three-particle correction. The change is such that only the momentum distribution of the particles is altered by the three-particle correlations. The single-particle energy spectrum is unchanged from the two-particle result. A number of approximations are made which enable an easy numerical calculation of the change in the binding energy per particle resulting from the three-particle correlations. It is found in the neighborhood of the nuclear density that the correction to the "best" two-particle theory is small, in quite good agreement with Bethe's results. Several arguments are given to justify the selection of the "best" two-particle Green's function theory. Finally, it is demonstrated that any of the two-particle theories can be brought into exact agreement with third-order perturbation theory by including the corrections calculated here. (Diss. Abstr.)

53255 A SELF-CONSISTENT MICROSCOPIC THEORY OF THE NUCLEAR COLLECTIVE HAMILTONIAN. Johnson, Robert Edward. Philadelphia, Univ. of Pennsylvania, 1967. 175p.

Thesis.

The development of a microscopic theory of the Bohr–Mottelson Hamiltonian which describes vibrational and rotational collective motion in heavy nuclei is presented. It is shown that one can derive a closed set of equations from which the parameters associated with the collective Hamiltonian can, at least in principle, be determined self-consistently. The derivation is based upon the

generalized Hartree Fock approximation which was formulated by Klein and Kerman. This approach avoids two of the fundamental short-comings of the original phenomenological approach to the collective Hamiltonian. It is not necessary to give explicit definitions of the collective coordinates either in terms of the shape of the nuclear surface or in terms of the nucleon coordinates. The difficulty associated with having to quantize the classical expression for the collective Hamiltonian is not encountered since this operator is introduced at the start in quantum-mechanical form. The application of the equations of theory is presented in the study of collective motion which can be described by a single collective variable, (for example, one-dimensional vibrations or monopole vibrations). The equations are then treated according to a systematic approximation procedure. The usual result of the random phase approximation for the energy of harmonic vibrations is obtained. The standard B and C parameters are obtained up to an irrelevant scale factor. The equations which give the cubic terms of the collective Hamiltonian are presented. By the use of certain simple models, this one-dimensional vibrator is studied in more detail. This study suggests that the systematic approximation procedure is valid provided the number of interactions between occupied and unoccupied Hartree–Fock orbitals is sufficiently large. In the context of these models, the anharmonic cubic and quartic parameters are computed and their contribution to the vibrational energy is examined. It is seen that in the adiabatic region the equations simplify since the effect of the purely potential energy terms of the collective Hamiltonian dominate. A simple model is used to study the effect of the additional solutions of the RPA equation for the collective energies. The theory is applied to the problem of quadrupole vibrations of a spherical nucleus. Here the geometric or transformation properties of the collective variables are critical. Finally, the theory is applied to the problem of β and γ vibrations of a deformed nucleus with quadrupole equilibrium shape. The moment of inertia and the fundamental vibrational energies are computed, and the equations which yield the parameters pertaining to the leading rotation–vibration interaction terms are presented. (Diss. Abstr.)

53256 FOUR-BODY CORRELATION IN NUCLEAR MATTER. Kuriyama, Atsushi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 40: 301-16(Aug. 1968).

The Bethe–Faddeev equation for the four-body correlation in nuclear matter is given and solved using Day's approximation. The relation between Bethe's and Day's approximations is discussed using a perturbation method. It is found that the Bethe–Faddeev equation for the four-body correlation obtained under Day's approximation becomes indefinite and this relates to the divergence of the series of perturbation. It is found that the outer part of two-body correlation leads to the extension of the four-body correlation range and to the more attractive contribution to the binding energy of nuclear matter. The four-body correlation energy shows a large density dependence and is less than −1 MeV per nucleon at normal density. (auth)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 51043, 51061–51063, 51147, 51160, 52154, 52158, 52303, 53431, and 53490.

53257 (AECL–2716) INSTABILITIES IN FLOW THROUGH MULTIROD BUNDLES AND THEIR EFFECT ON DRYOUT. Carver, M. B.; D'Arcy, D. F.; Wikhammer, G. A.; Casterline, J. E.; Matzner, B. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Sept. 1968. 18p. (CONF-680903–2). Dep. CFSTI. CAN $0.50.

From International Symposium on Research in Cocurrent Gas-Liquid Flow, Waterloo, Ontario.

Flow instability experiments have been done on electrically heated 19-element bundles in a forced circulation water loop. To simulate parallel channel geometry, an unheated flow bypass was connected in parallel with the test section. The heated length was nine feet; maximum bundle power was 3.5 MW. Test section flows to 300 lb/ft^{2}s, inlet subcoolings from about 20°F to 180°F, and outlet pressures of 150, 500, 750, 1000 psia, were tested. Each test was terminated at the occurrence of a sustained oscillation of the test section flow, dryout, or both. Comparable tests were also made with the bypass valved out, and flow oscillations did not occur. These tests were terminated on the appearance of dryout. Flow stability in the bundle was also assessed using a computer code POISE, which had been developed previously and had shown good agreement with experiments on heated channels of simple geometry. The code predicts onset of flow oscillations at powers slightly lower than experimental points. Results suggest that the usual geometrical parameters of flow area, heated perimeter and wetted perimeter are not adequate to describe dynamic flow behavior in a complex cross sectional geometry; and steady state radial flow distribution within the bundle is not maintained during oscillations. (auth)

53258 (AERE-PGEC/L–194) ENGINEERING ASPECTS OF NUCLEAR REACTORS. Taylor, D. J. (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 16p. Dep. CFSTI. UK.

The subject is discussed under the headings: place of engineering; choice of reactor system; fuel elements (fuel temperature, Magnox fuel, phases of U metal, irradiation growth, irradiation swelling, canning, temperature, AGR fuel, fuel canning material, heat transfer); moderator (mechanical effects, mass transfer, Wigner energy); coolant (operating pressure, choice of gas); pressure vessels (steel pressure vessels, prestressed concrete pressure vessels); reactor control (control rod design, instrumentation); fission product detection; fuel element handling; shutdown heating; conventional plant; siting policy; economic considerations. (UK)

53259 (AI-AEC–12572) RETIREMENT OF THE SODIUM REACTOR EXPERIMENT. Eggleston, R. R. (Atomics International, Canoga Park, Calif.). Aug. 30, 1968. Contract AT(04-3)-701. 114p. Dep. CFSTI.

The SRE plant and post-operational programs are briefly described. The retirement program is described in detail together with the alternative plans that were considered. The current status of the plant is described and the means presented whereby the plant will be maintained in its present condition. The time and cost schedule to accomplish the retirement is included. Finally, recommendations are made that would be useful to future retirement efforts. (auth)

53260 (ANL–7425, pp 130–71) REACTOR SAFETY. (Argonne National Lab., Ill.).

A description of the CHEMLOC-II computer program is presented for calculation of the extent of metal-water reaction, core heating, and core motion after thermal reactor loss-of-coolant accident. A loss-of-accident computer simulation for a 3300 MW(t) boiling water reactor is described. Graphical results are presented. The use of the TREAT facility for laboratory simulations of loss-of-coolant accidents is described. Meltdown experiments with Zircaloy 2-clad UO_2 pelletized and vibra-packed fuel rods are described. Heat transfer studies for hot metal objects in water are presented. Experimental and theoretical predictions are analyzed. The measurement of heat capacity of UO_2 for fast reactors is described. Heat transfer reactions for molten materials in water are calculated. A sprayed sodium-air reaction is described. Thermal migration studies are described for PuO_2–UO_2 fuel pellets. (D.C.C.)

53261 (BAW–3809-4) POSTIRRADIATION EXAMINATION OF THORIA–URANIA FUEL RODS. Quarterly Progress Report No. 4, March–May 1968. Bishop, W. N.; Baroch, C. J. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). July 1968. Contract AT(30-1)-3809. 23p. Dep. CFSTI.

Isotopic and metalurgical analyses on ThO_2–UO_2 fuel, stainless steel cladding, and Zircaloy fuel can form Core A of Indian Point Power Reactor, Unit 1 are described. Profilometer measurements and metallographic examinations are presented. (D.C.C.)

53262 (BNL–12757) PuO_2–UO_2–Na AEROSOLS PRODUCED BY VAPORIZATION OF FAST REACTOR CORE MATERIALS. Horn, F. L.; Castleman, A. W. Jr. (Brookhaven National Lab., Upton, N. Y.). [1967]. 19p. (CONF-680811–8). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

In the case of a Na-cooled fast breeder reactor fueled with PuO_2–UO_2, the hypothetical accident includes gross melting of the fuel, compaction of the core producing a prompt critical reactor period, followed by vaporization of fuel and coolant to the containment vessel. The resultant vapor will condense into an aerosol composed of PuO_2 and UO_2 mixed with Na. The time dependent behavior of the aerosol with respect to coagulation, settling, wall plating, particle size distribution, and particle density is studied. (auth)

53263 (BNWL–700) TECHNICAL PUBLICATIONS OF BATTELLE-NORTHWEST DURING 1967. Neef, D. E. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1968. Contract AT(45-1)-1830. 37p. Dep. CFSTI.

Formal research and development reports and technical articles published during 1967 by Battelle–Northwest are listed under the following subject categories: biology and medicine; chemistry and chemical engineering; earth and atmospheric sciences; electronics and computer technology; engineering and equipment; general; health and safety; mathematics; metals, ceramics, and materials; physics; radiation effects; and reactor technology. An author index is included. (H.L.W.)

53264 (BNWL–833) FUEL CYCLE COSTS FOR HEAVY WATER REACTORS. Bloomster, C. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 24, 1968. Contract AT(45-1)-1830. 33p. Dep. CFSTI.

The effects of important economic and fuel design parameters on fuel cycle costs are calculated for a simulated 1000 MW(e) HWR based on the Pickering reactor and fuel design. (auth)

53265 (BNWL-SA–2063) STEAM-COOLED FAST BREEDER REACTORS. Aase, D. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 27, 1968. Contract AT(45-1)-1830. 25p. (CONF-680818–2). Dep. CFSTI.

From Topical Meeting on Fast Reactors and the Universities, Troy, N. Y.

The development of a parametric study on steam-cooled fast breeder reactors is described. Results of the study are presented and indicate: that fuel cycle costs are very weakly affected by choice of steam pressure; that choice of steam pressure is made for optimum capital cost or optimum breeding ratios; that design configuration directly affects breeding ratio; and that reduction in hydraulic resistance benefits breeder performance at low steam pressure. (D.C.C.)

53266 (DOCKET-50244–6) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Final Facility Description and Safety Analysis Report, Amendment 11, Suppl. 5, Exhibit D-10. (Rochester Gas and Electric Corp., N. Y.). Oct. 17, 1968. 28p. Dep. CFSTI.

An analysis of the design of large openings in containment vessels is given for the Robert E. Guina Power Reactor, Unit 1. Design problems and construction procedures are described. Hoop stress resultants along horizontal and vertical symmetry axes are shown graphically. Engineering drawings are included. (M.L.S.)

53267 (DOCKET-50245–5) MILLSTONE NUCLEAR POWER STATION, UNIT 1. [Final Safety Analysis Report], Amendment 8. (Connecticut Light and Power Co., Hartford. Hartford Electric Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). Sept. 17, 1968. 230p. Dep. CFSTI.

A comparative evaluation of the design for Millstone Power Reactor, Unit 1, with the AEC's proposed 70 General Design Criteria

is given. Revised pages for the original Final Safety Analysis Report, Vols. 1, 2, and 3 are included. (M.L.S.)

53268 (DOCKET-50250-1) EFFECT OF THE MODERATOR COEFFICIENT ON CORE STABILITY. French, R. J.; Strawbridge, L. E.; Barry, R. F. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Sept. 1966. 41p. (DOCKET-50251-1; WCAP-2987). Dep. CFSTI.

Suppl. 6 for Florida Power and Light Co.

The report, WCAP-2987, "Effect of the Moderator Coefficient on Core Stability" is presented in its entirety in support of the license application for Turkey Point Power Reactor, Units 3 and 4. (M.L.S.)

53269 (DOCKET-50286-5) INDIAN POINT NUCLEAR GENERATING, UNIT NO. 3. Preliminary Safety Analysis Report, Suppl. 2, Exhibit B-2. (Consolidated Edison Co. of New York, Inc., New York). Sept. 16, 1968. 95p. Dep. CFSTI.

Information on the containment design for Indian Point Power Reactor, Unit 3, is given. Structural design data, including details of the base-slab, dome-cylinder junction, and liner anchors, are included. Seismic design of the containment structure is described. Construction materials and procedures are discussed. Quality control procedures and testing programs are described. (M.L.S.)

53270 (DOCKET-50308-1) BOLSA ISLAND NUCLEAR POWER AND DESALTING PLANT. Preliminary Safety Analysis Report, Volume 1, Part B. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Aug. 1967. 225p. Dep. CFSTI.

Information on the Bolsa Island Power Reactor, Unit 2 is given under the following main headings: Introduction and Summary and Site and Environment which includes site development, geology and seismicity, soils, oceanography, hydrology, meteorology, and siting criteria. (M.L.S.)

53271 (DOCKET-50321-5) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. [Preliminary Safety Analysis Report], Amendment 1. (Georgia Power Co., Atlanta). Aug. 12, 1968. 160p. Dep. CFSTI.

Revised or supplemental information on the Edwin I. Hatch Power Reactor, Unit 1, is given on the following major topics: identification and qualifications of applicant and principal contractors, and quality assurance program; and analyses of radiological effects of design basis accidents. Appendices include a comparative evaluation of plant design with the AEC Design Criteria and technical notes on the significance of tritium in water reactors. (M.L.S.)

53272 (EUR-4042) REACTIVITY CONTROL MECHANISMS OF A 250 MWe ORGEL REACTOR. Noailly, J.; Scheurer, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 6, 1968. 70p. (In French). Dep.

Different studies which have been executed in the scope of the ORGEL Programme are described. The control mechanisms of a 250 MW(e) reactor are discussed. The reactor trimming is done by a system of solid or gaseous rods (He rods), its scarmming is done by a system of liquid rods (two different types have been examined) or also by gaseous rods. The large and slow reactivity variations are compensated by a moderator poison system working with $CdSO_4$. The working principles and specifications of the different control devices are described. (auth)

53273 (EURFNR-472) DEVELOPMENT OF FUEL ELEMENTS FOR FAST BREEDER REACTORS. Beisswenger, H.; Blank, H.; van den Boorn, H.; Geithoff, D.; Haefele, W.; Kaempf, H.; Karsten, G.; Kummerer, K.; Laue, H. J.; Leistikow, S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-700. 423p. (EUR-3713). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The 13 papers presented were previously abstracted from the original language. Separate abstracts for all 13 papers are listed in NSA Vol. 22 as: 32772, 32773, 32774, 32775, 32776, 32777, 32778, 33092, 33093, 33094, 33095, 33096, and 33097. (D.C.C.)

53274 (EURFNR-544) CONTROL ROD CALCULATIONS FOR THE STEAM COOLED FAST BREEDER REACTOR D-1. Klippel, H. Th. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). July 1968. 64p. (EUR-3961; KFK-792). Dep.

Work performed under United States-Euratom Fast Reactor Exchange Program.

For the steam cooled fast breeder reactor D-1 the optimization of the location and management of the control elements is performed in a first step. With one-dimensional diffusion code calculations those locations of one and two rings of control and safety elements are determined which will result in the maximum shutdown reactivity. Perturbation theory provides an expression to calculate the control rod worth of two rings of absorber elements using the results of the calculations for two single rings. For the optimum ring radii of two rings of control elements that procedure of inserting some control rods a certain depth is determined which maintains the reactor critical with the most favorable power distribution. These calculations are done in two-dimensional (r-z) and (r-θ) geometries. To show the effect of homogenization of the absorber material in a cylindrical ring, some (r-θ) calculations were performed indicating the influence of the absorber rod perimeter on the reactivity worth of the rods. The calculations were performed with the Karlsruhe Nuclear Program System NUSYS. (auth)

53275 (GEAP-5616) NINE-ROD CRITICAL HEAT FLUX INVESTIGATION, STEAM-WATER AT 600 TO 1400 PSIA. Final Summary Report. Janssen, E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr. 1968. Contract AT(04-3)-189. 58p. Dep. CFSTI.

Critical heat flux (CHF) data were obtained in two "clean" nine-rod test channels. The heat flux was uniform in the axial direction. Data were obtained both with all rods uniformly heated and with one of the corner rods slightly (on the order of 10%) higher than the average. The flow was varied from 0.3×10^6 to 1.25×10^6 lb/h-ft^2, and the pressure was varied from 600 to 1400 psia. Results indicate that: for rods in a normally-spaced square array, the CHF occurs on one of the corner rods; the CHF decreases as the average quality increases, other things being the same; there is no strong or consistent effect of length on CHF; there is no flow effect on CHF for flows greater than 0.75×10^6 lb/h-ft^2. In the range of pressures from 600 to 1400 psia, the CHF varies in an inverse manner with the pressure, other things being the same; and a reduction in rod-to-wall clearance from 0.135 inch to 0.060 inch causes a 15% reduction on CHF. Multisubchannel computer codes consider channel conditions in more detail, thus providing the means for a possible improvement in the correlation of multirod CHF data. Two such codes were investigated, the COBRA (Battelle Northwest) and the HAMBO (U.K. Atomic Energy Establishment, Winfrith). Each of these, in combination with a simple channel (internally-heated annulus) CHF correlation, was used to predict CHF in the nine-rod channel. Fair to good agreement was obtained between predicted and measured CHF. The use of such codes appears to be a promising procedure for predicting CHF in a multirod array. (auth)

53276 (HMI-B-76) CHEMICAL ASPECTS OF REACTOR SAFETY (LITERATURE REVIEW). 3rd Semiannual Report Commissioned by the Government Ministry for Scientific Research. Hoinkis, E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Aug. 1968. 33p. (In German). Dep.

A literature review of the chemical aspects of reactor safety is given. Release and absorption of noble fission gases are discussed; fission product release from coated particles and fuel and clad materials is considered. Release and absorption of fission product iodine is described. Efforts in filtration of aerosols are summarized; metal-water reactions are discussed. The steam oxidation of graphite and coated particles is described; corrosion aspects of reactor safety are outlined. Chemical reactions involving fuel material are discussed; the chemical problems involved in working with sodium coolants are detailed. 82 references. (M.L.S.)

53277 (KFK-539/2) STRUCTURE, EXPANSION, AND DISTORTION EFFECT IN THE FAST REACTOR. PART II. PROGRAM DESCRIPTION. Hoang, Y. S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan. 1967. 30p. (In German). (EUR-3951(Pt.2)). Dep.

The four FORTRAN II programs used for determination of effects of fuel element subassembly swelling in a fast reactor are discussed. The use of DANGER, SPALTR, TEMPER, and REAKSP for these calculations is described. 15 references. (M.L.S.)

53278 (KFK-539/3) STRUCTURE, EXPANSION, AND DISTORTION EFFECT IN THE FAST REACTOR. PART III. USE ON Na-1 REACTOR. Hoang, Y. S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan. 1967. 37p. (In German). (EUR-3951(Pt.3)). Dep.

Application of the fast reactor codes to the Na-1 Reactor is discussed; design data and material compositions are tabulated for a single reactor zone. Danger coefficient plots are shown graphically; coolant temperature profiles are shown for typical fuel subassemblies. Schematic representation of fuel element deformation is shown as a function of fuel element length and

radius; deformation effects on reactivation are evaluated. 14 references. (M.L.S.)

53279 (LMEC-Memo-68-21) HNPF PUMP TEST LOOP FINAL SYSTEM DESIGN DESCRIPTION. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). Sept. 4, 1968. Contract AT(04-3)-700. 76p. Dep. CFSTI.

The Hallam Nuclear Power Facility pump test loop system design is described, and the loop functions and capabilities are presented. The test installation provides for: (1) testing Hallam prototype freeze seal and free surface centrifugal pumps; (2) testing a helical rotor electromagnetic pump; (3) evaluation of shell-side heat transfer experiments on sodium-to-sodium heat exchangers; (4) calibration of sodium flowmeters; and (5) testing of sodium components such as valves and coolers within pressure, flow, and temperature limits. (H.D.R.)

53280 (NP-17638) OECD HALDEN REACTOR PROJECT. Eighth Annual Report, 1967. (Organization for Economic Co-Operation and Development, Paris (France)). 176p. Dep. CFSTI.

Operations and maintenance performed during 1967 in the Halden Boiling Reactor are described. Plant modifications and radiation control procedures are also described. Progress on the development of an on-line computer control system is discussed. (D.C.C.)

53281 (NYO-3906-3) ULTRASONIC THERMOMETRY IN LMFBR SYSTEMS. Third Quarterly Progress Report, April 1-June 30, 1968. Fam, S.; Lynnworth, L. C.; Carnevale, E. H. (Panametrics, Inc., Waltham, Mass.). June 1968. Contract AT(30-1)-3906. 14p. Dep. CFSTI.

The testing of an ultrasonic system to measure temperature in the coolant, cladding and fuel meat of liquid metal cooled fast breeder reactors (LMFBR's) is described. Sodium immersion tests were conducted up to 700°F. These tests: demonstrated lead-wire transmission through liquid Na, with ~20 ft sections of lead-in wire both directly immersed in liquid Na and also contained in an immersed sheath; determined the feasibility of using the immersed fuel cladding as a temperature sensor; determined the feasibility of using sheathed tungsten and/or SS 304 as lead-in wires; and demonstrated the structural integrity of the ultrasonic thermometer with respect to the liquid Na environment. Several types and sizes of commercially available wire were evaluated for the transducer coil. The most satisfactory compromise for a combined transmit/receiver coil from the standpoints of reliability, voltage breakdown, signal amplitude and stability, was found in #40 Niclad wire. (auth)

53282 (ORNL-TM-2256) CHEMICAL FEASIBILITY OF FUELING MOLTEN SALT REACTORS WITH PuF_3. Thoma, R. E. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 37p. Dep. CFSTI.

The feasibility of starting molten salt reactors with PuF_3 is evaluated with respect to chemical compatibility within fuel systems and to removal of Pu from the fuel by chemical reprocessing after ^{239}Pu burnout. Compatibility within reactor containment systems is moderately well-assured but requires confirmation of PuF_3 solubility and oxide tolerance before tests can be made using the MSRE. Although separation of Pu and Pa in the chemical reprocessing plant, as would be desirable in a large breeder reactor, has not yet been demonstrated, conceptual designs of processes for effecting such separations are available for development. 20 references. (auth)

53283 (ORNL-tr-1940) REPORT ON A SURVEY RELATED TO EARTHQUAKE-RESISTANT DESIGNS OF NUCLEAR REACTORS. (Ministry of Trade and Industry, Tokyo (Japan). Committee for Safety Specifications for Nuclear Power Plants). Translated for Oak Ridge National Lab., Tenn., from Japanese report. 158p. Dep.

The basic factors in the earthquake-resistant design of nuclear power plants are outlined; the philosophy behind the design is examined. Effects of reactor site and basic soil structure are analyzed; seismic activity is considered. Earthquake intensity scales and ground acceleration values are tabulated and discussed; some response spectra are shown graphically. Structural design and methods of designing earthquake-resistance into reactor structures are detailed; vibrational characteristics of construction units are discussed; dynamic analysis of buildings is considered. Earthquake resistant design for equipment and distribution lines is described; analytical methods for calculating loadings, stresses, and dynamics of the equipment and systems are discussed in detail. The need for surveys and research is outlined. Japanese activities relating to earthquake-resistant nuclear power plant design and construction are discussed. (M.L.S.)

53284 NUCLEAR FUEL MANAGEMENT. Casey, Suzanne R. (Commonwealth Edison Co., Chicago); Fulford, P. J.; Swanson, Richard. Power Eng., 72: No. 9, 46-8(Sept. 1968).

The major aspects considered in calculating the economics of supply, utilization, and salvage of fuel for nuclear power plants are described. Problems associated with accounting methods for nuclear fuel are discussed, and the use of the straight-line unit of production method is described. (H.D.R.)

53285 1,000-TON PORTABLE CRANE LIFTS NUCLEAR REACTOR VESSEL. Riley, Walter E. (Consulting Engineer, Phoenix, Ariz.). Civil Eng. (N. Y.), 38: No. 6, 70-2(June 1968).

A description of a 1000 ton capacity portable crane is presented. The crane is used for installing nuclear reactor vessels. (D.C.C.)

53286 NUCLEAR REACTOR POWER PLANTS BREAKDOWN. Ceuzin, Paul. Sci. Avenir, No. 254, 314-17(Apr. 1968). (In French).

The last 3 nuclear power stations constructed in France (Chooz, Brennelis, Chinon) have recently had shutdowns for technical problems. Chinon was stopped by leaks in the heat exchangers and the rupture detection system on 10 October 1966. Chooz was stopped in January 1967 by a fire, and in February 1968 by vibrations in the reactor core. The prototype heavy-water power plant EL 4 was shut down by heat exchanger problems. However, France is not alone in these problems. There have been 24 American shutdowns recently, 5 in Italy, 5 in Great Britain, 1 each in Canada and Sweden, 2 in Germany, and 4 in Japan; these are listed and the causes, where published, tabulated. (BBB)

53287 THE BREEDER REACTORS AFTER THE FORATOM CONGRESS. Labrousse, Michel. Ann. Mines, No. 111, 7-26 (Mar. 1968). (In French).

Fundamental studies of breeder reactors have been completed; prototypes of future commercial reactors are projected, with a joint European effort (Great Britain, France, and Germany) contrasting with the American effort. From a technical viewpoint there are 2 European reactors (DFR, Rapsodie) against the American EBR II. Of the 150 tons of Pu in reactors in 1980, 67 will be in America, 53 in the large European states (70 with Italy, Sweden, etc.); annual production will be 16 tons in the U.S.A. against 9 for the 3 European countries. The U.S.S.R. has announced that it will not await functioning of the BN 350 before projecting a 600 MWe plant for 1971. Data for 6 European commercial reactors are tabulated (1 British, 1 French, 2 German, 2 Belgian). (BBB)

53288 VARIOUS ASPECTS OF MATERIALS FOR THERMAL INSULATION OF BOILING WATER POWER REACTORS AND THE EXPERIENCE OBTAINED IN THE SANTA MARIA DE GARONA. Barandiaran, Miguel. Energ. Nucl. (Madrid), 12: 108-14(Mar.-Apr. 1968). (In Spanish).

The role of shielding of a boiling water power reactor is discussed; the shielding for the Santa Maria de Garona Power Reactor is described. The necessity for contamination control at nuclear power plants is evaluated. The relation between the reactor building and the containment systems is discussed; the reactor building for Santa Maria de Garona is discussed. (M.L.S.)

53289 PRESENT STATUS OF RESEARCH AND DEVELOPMENT ON SAFEGUARDS TECHNIQUES. Haginoya, Tohru. Nippon Genshiryoku Gakkaishi, 10: 502-6(Sept. 1968). (In Japanese).

The development of safeguards techniques increases in importance with the widening practical application of nuclear power generation. The most effective manner of applying safeguards measures is to cover the entire fuel cycle, with inspections conducted on the key points of the fuel cycle. The success of such a procedure would depend on improvements in available safeguards technique. Developments in this domain must be pursued along two lines — instrumentation and systems. In every case, the strategic point is the reprocessing plant and not the nuclear reactor itself. (auth)

53290 NEW MODEL FOR TRANSIENT ANALYSIS OF SELF-PRESSURIZED WATER REACTOR PLANT. Maeda, Hiizu; Tsuda, Junji; Hagi, Yogo (Hitachi Ltd., Japan. Hitachi Electronics Co., Ltd., Japan). Nippon Genshiryoku Gakkaishi, 10: 478-87(Sept. 1968). (In Japanese).

The results of hybrid computer model studies performed to determine the transient characteristics of a self-pressurized water reactor plant are described. The plant has a H_2 overpressure mechanism, with a steam dome on the top of the vessel in lieu of a separate pressurizer. The transient conditions inside this steam dome which characterizes the plant are analyzed. Noncondensing processes are treated with four gas conditions (adiabatic mixed gas; isoentropic, isoenthalpic and saturated steam), as well as various condensing processes, with particular reference to condensing processes with saturated steam and with limited condensation. The method of computation adopted describes the two processes of compression and expansion under

a single unified system. The method is applicable to other non-condensing gas overpressure mechanisms, to ordinary self-pressurized reactor plants, and to conventional PWR pressurizer analysis. A hybrid computer (ordinary analog computer connected with the digital computer HITAC 2010) was used for the characteristics computation. Some examples are given of the results obtained. (auth)

53291 POWER REACTOR TYPES AND BURNUP CHARACTERISTICS. Kiyose, Ryohei (Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 10: 496-501(Sept. 1968). (In Japanese).

The burnup performance of various power reactor types, including gas-cooled graphite moderated, light-water moderated, heavy-water moderated and fast breeder reactors, is discussed in conjunction with fuel management schemes applicable to these reactor types. A review is presented covering the progress made in studies on burnup analysis of power reactors, and need is felt for further studies in domains such as burnup and fuel management codes, mathematical models useful for burnup or fuel cycle optimization, and experimental methods of burnup determination. (auth)

53292 EXPERIMENTAL AND THEORETICAL STUDIES OF REACTIVITY COEFFICIENTS OF IMPORTANCE FOR FAST REACTOR SAFETY. Tiren, Ingmar. Goteborg, Chalmers Tekniska Hoegskola, 1968. 23p.

Thesis.

A summary is made of 6 published papers by the author and co-authors on the following subjects: measurement and analysis of reactivity effects in empty channels in a fast reactor; tables related to the mean square chord length in right parallelepipeds; studies of the reactivity of polyethylene in the fast reactor FR-O; studies of the effect of heavy water in the fast reactor FR-O; activation Doppler measurements on ^{238}U and ^{235}U in some fast reactor spectra; and comparison of theoretical and experimental values of the activation Doppler effect in some fast reactor spectra. (Swed)

53293 ATOMIC REACTOR WITH MODERATOR LEVEL CONTROL AND XENON OVERRIDING. Keller, W. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 785,877. May 21, 1968. Priority date June 28, 1963, Germany.

Reactivity control is achieved by placing an enriched fuel bundle at the top of the fuel channel in a position above the moderator level during normal operation. The moderator level is raised after a power cycle so that the enriched bundle serves the same purpose as a booster rod to overcome the Xe poison effect. (F.S.A.)

53294 APPLICATION OF STEAM GENERATOR IN POWER STATIONS WITH SODIUM COOLED REACTORS. Dubsek, Frantisek (Research Inst. of Power Plant Installations at the First Brno Machine Construction Plant, Brno). Jad. Energ., 14: 249-55(July 1968). (In Czech).

Construction characteristics of steam generators for Na cooled reactors are analyzed. Descriptions are given of the design of a steam generator consisting of aggregates for the BN-350 power plant using the technology of the A-1 steam-generators. (tr-auth)

53295 TURBINE-GENERATOR FOR WINFRITH HEATH. G.E.C. J. Sci. Technol., 35: 67-8(1968).

The 100-MW turbine-generator for the Winfrith SGHWR is described. The saturated steam turbine is a 3000 rpm, two cylinder, close-coupled, tandem-compound straight condensing machine with a Baumann multi-exhaust. The two-pole cylindrical-rotor generator produces 13.8 kV, 3-phase, 50 Hz. (UK)

53296 REGULAR INSPECTION IN FISCAL 1967 OF THE JAPC TOKAI POWER STATION. Iwakoshi, Yonesuke (Japan Atomic Power Co., Tokyo). Karyoku Hatsuden, 19: 82-4(Jan. 1968). (In Japanese).

The Tokai power station employs an improved Calder Hall type reactor with electric output 166 MW(e). It first produced electric power in November 1965 and the full power operation in trial was carried out in February 1967. Subsequently the first regular inspection was performed from April to June 1967; the total cumulative power output then was 605,461 MWh. The inspection was not truly a "regular" one since the power station was in a transient stage from completion of the station to the commercial electric production; it was of the nature of inspecting its over-all aspects and repairing the detected defects. Descriptions are made in the following: devices for measuring fuel temperatures; control rods; insertion and withdrawal of test specimens; safety valves; the primary coolant circuit. (NSA of Japan)

53297 DUNGENESS B: THE BOILER CONFLICT. Engineering, 206: 392-3(Sept. 1968).

Conflicting requirements to withstand the gas-induced vibration and corrosion were met in the design of the boiler-tube support system. The special research programme necessary to resolve the conflict is summarized. (auth)

53298 WHAT NEXT FOR NUCLEAR ENERGY. Tape, Gerald F. (Atomic Energy Commission, Washington, D. C.). S. Afr. Mining Eng. J., 79: 1268-74(May 17, 1968).

In 1967, electric utilities made known plans for 32 nuclear power plants. The cumulative cost of all plants announced to date will be about $10.5 billion. The total purchase price for nuclear fuel over the plant life times will be about $20.5 billion. By the year 1980 the Federal Power Commission has estimated that the total U. S. electrical energy requirements will be 2.7×10^{12} Kwh. Statistics, history, and incorporation of technological advances of the San Onofre Nuclear Generating Station and the Connecticut Yankee Atomic Power Plant are described. The molten salt breeder reactor and fast breeders are discussed. Problems of cooling are noted. Reactor uses in the immediate future are proposed. (BBB)

53299 NUCLEAR POWER CAN CONSERVE RESOURCES. Roux, A. J. A. (Atomic Energy Board, Capetown). S. Afr. Mining Eng. J., 78: 2157(Sept. 15, 1967).

Of all recent scientific developments, perhaps nuclear power can make the greatest contribution to the conservation of natural resources. At the present rate of increase in demand, South Africa will run out of coal 100 years from now. South Africa has the western world's second-largest reserves of low-cost U. South Africa's power supply system has consisted of comparatively small coal-fired stations built near the load centers. By 1990, South Africa's power requirements will have risen from the present 7000 MW to 32,300 MW. Nuclear power in the Transvaal will not be able to compete with coal-fired stations in the near future. The existence of a national grid implies large power stations with high load factors; under these conditions nuclear power stations are economical. This may well make nuclear power competitive in the Transvaal in the 1980's. Based on present cost structures, indications are that coastal nuclear power stations will be competitive by the latter half of the 1970's. These coastal nuclear stations will be sited in the vicinity of the major load center and connected to the national grid. (BBB)

53300 NEUTRONICS OF POWER REACTORS. Bussac, Jean. Atomes (Paris), 23: 295-302(May 1968). (In French).

Principles of chain reactions carried by fission neutrons are reviewed; the dependence of neutron density evolution on reactivity is illustrated. Construction of various pile elements is outlined, especially those which function as moderators. Formation of a breeder reactor with ^{238}U is explained, and the necessity of enrichment traced to low cross-sections. Economic problems of heat extraction from the potentially compact reactor lead to a finely divided fuel (needles 6 mm in dia) and an efficient coolant for maximum specific power (50 MW/t, 0.35 MW Kg fissile) are reviewed. Fast neutron piles have a density 10 to 100 times those of thermal piles, posing mechanical resistance problems for heavily irradiated structures. The level of combustion must necessarily be 50,000 to 100,000 MWJ/ton; rapid neutron piles fed by Pu have a 44% thermodynamic yield and low pressure with molten Na. Instability features of the pile after long irradiation are noted; the conversion of ^{135}Xe to ^{136}Xe prevents this isotope from becoming a nuisance. Slow development of spatial oscillation in neutron density is shown to occur. Problems of consumption of U, and methods of handling partial recharging, are reviewed, particularly approaches to recharging without stopping the pile. (BBB)

53301 THE ATOMIC BREAKTHROUGH IN THE EAST. Malleroy, Antoine. Atomes (Paris), 23: 194-6(Mar. 1968). (In French).

Certain east European countries, namely Bulgaria, Hungary, and Rumania, intend to import nuclear power stations; others will develop their own. Bulgaria and Hungary have decided to acquire Soviet 800-MW(e) Novovoronei type plants. The Bulgarian plant will be at Kozlodny. Hungary will furnish U from Koevogoszoelloes to the U.S.S.R. for enrichment and formation into elements. Rumania is examining the products of western European firms, with an objective of a 1000-MW(e) unit or units by 1975. East Germany and Czechoslovakia will develop their own nuclear power industry based on Soviet technology; the first plant of East Germany (Rheinsberg, 70 MWe) is a Soviet model. Czechoslovak engineers began to study the Jaslowske Bohunice plant at Leningrad in 1956. A 150-MW(e) unit at Piestany is giving a modest performance. A 300-MW(e) unit is scheduled for completion in 1969, and a 500-MW(e) unit planned. Certain members of the plan Commissariat have complained of the weak base of nuclear physics in Czechoslovakia; others have contested the importance of the atom. The committee on atomic energy now takes responsibility for the Rez and Prague laboratories and the budget has been revised upward to 11%. (BBB)

53302 ACCIDENT ANALYSIS FOR JPDR-II. Osanai, Masao; Sato, Kazuo (Japan Atomic Energy Research Inst., Tokyo). Karyoku Hatsuden, 19: 85-9(Jan. 1968). (In Japanese).

JPDR, which will be altered to JPDR-II, is a BWR type reactor of natural circulation with 45 MW(t) operated for the past four years. The purpose of the Japan Power Demonstration Reactor (JPDR) is the obtaining of experiences of its construction, operation and maintenance, and the grasping of its operating characteristics. In the JPDR-II, which will be used for irradiation of nuclear fuels in connection with domestic production of power reactors, the power will be doubled, i.e., to 90 MW(t) by changing it to the forced circulation with attendant alterations. The accident analyses, performed for JPDR-II, and the results are described in the following: coolant loss; rupture of the main steam pipe; operation start-up; dropping of the control rods; coolant flow loss; entrance of cold water; withdrawal of the control rods at high power. (NSA of Japan)

53303 THERMAL INSULATION FOR REINFORCED CONCRETE PRESSURE CONTAINERS. Wuerdig, P. (Deutsche Babcock and Wilcox AG, Oberhausen, Ger.). Atomwirt., Atomtech., 13: 211-14(April 1968). (In German).

Descriptions of the research and testing of thermal insulation for reinforced concrete pressure vessels for power reactors are given. A cross section of the test vessel used in the research is shown; brief descriptions of the various component systems are included. Results of measurements are shown graphically; practical uses are described briefly. (M.L.S.)

53304 OPERATING EXPERIENCE WITH NUCLEAR POWER STATIONS. Weckesser, A. (RWE-Bayernwerk GmbH, Gundremmingen, Ger.). Atomwirt., Atomtech., 13: 190-7(April 1968). (In German).

A summary of world nuclear power plant operating experience is given. Power production before 1966 is compared to projected estimates for 1966–1970. Average power densities for gas-cooled, pressurized water, and boiling water reactors are tabulated. Availabilities of various reactors are tabulated from 1957 through 1967. Percent downtime is given, on a per year basis, for Calder Hall. Startup characteristics are summarized for several reactors. Effects on reactivity of xenon buildup, boron concentration, and control rod positioning are discussed; load following ability is described. (M.L.S.)

53305 THE AVR HIGH TEMPERATURE REACTOR. EXPERIENCE FROM DEVELOPMENT TO COMMISSIONING: DESIGN AND CONSTRUCTION. Mueller, H. W.; Stuermer, W. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirt., Atomtech., 13: 201-4(April 1968). (In German).

A brief history of the construction of the AVR High Temperature Reactor is given. Fabrication and construction of the containment vessel and helium systems are described; inspection and quality control are discussed briefly. (M.L.S.)

53306 AVR HIGH TEMPERATURE REACTOR: EXPERIENCE FROM DEVELOPMENT TO COMMISSIONING: SAFETY ASPECTS. Lindackers, K.-H; Stoebel, W. (Technischer Ueberwachungs-Verein Rheinland eV, Cologne). Atomwirt., Atomtech., 13: 204-5(April 1968). (In German).

The safety scram features of the AVR High Temperature Reactor are described; trip set points are given. The effects of unintentional radioactivity release to the surrounding environment are discussed briefly. (M.L.S.)

53307 COMMISSIONING OF THE AVR GAS CIRCUITS. Cramer, H. (Brown Boveri und Cie/Krupp, Juelich, Ger.). Atomwirt., Atomtech., 13: 206-8(April 1968). (In German).

The gas-coolant circuits of the AVR High Temperature Reactor are described; circuit diagrams are shown. Testing of the circuits is described; the integral leak testing is discussed. The helium filling and purification systems are described. (M.L.S.)

53308 RESULTS OF THE FIRST AVR EXPERIMENTAL POWER OPERATION. Drechsel, W.; Hantke, H.-J., Schleifenheimer, K. (Brown Boveri/Krupp Reaktorbau GmbH, Juelich, Ger.). Atomwirt., Atomtech., 13: 208-10(April 1968). (In German).

The zero power testing program for the AVR High Temperature Reactor is described. A power history from startup through 23 MW(th) is shown. Simulation of loss of coolant and loss of primary feedwater pumps is described briefly; some reactor physics parameters are listed. (M.L.S.)

53309 IMPORTANCE OF SAFE CONTROL OF NUCLEAR REACTORS FOR SAFETY OF THE OPERATION OF A NUCLEAR POWER STATION. Drab, Frantisek (Nuclear Power Station Dept., Plzen, Czech.). Jad. Energ., 14: 330-4(1968). (In Czech).

Some principles are analyzed which must be respected in designing the system of safe control of a nuclear reactor in connection with requirements of high safety of nuclear power station operation and of the reliability of the control system. Some numeric relations are referred which indicate the dependence of the control system reliability on its design and operational parameters. These parameters indicate that the operational safety of a nuclear reactor substantially may be influenced even in the project of the reactor control system, the optimum reliability, however, is an economic question. 5 references. (auth)

53310 NUCLEAR PLANT STEAM GENERATORS. Byerley, W. M. (Westinghouse Electric Corp., Lester, Pa.). Power Eng., 72: No. 10, 44-9(Oct. 1968).

A description of a typical two-cycle flow configuration for a pressurized-water reactor is presented. Boiler fabrication techniques and quality control requirements are described. (D.C.C.)

53311 IMPROVEMENTS IN NUCLEAR REACTOR PLANTS WHICH INCLUDE STEAM GENERATORS. (to Sulzer Brothers Ltd.). British Patent 1,130,428. Oct. 16, 1968. Priority date June 25, 1965, Switzerland.

A description of a gas-cooled nuclear reactor is presented. The reactor consists of a concrete pressure vessel-contained core and steam generating system. The heat exchange units are located below the core and contain multiple horizontal flat tube coils stacked vertically. (D.C.C.)

53312 IMPROVEMENTS IN OR RELATING TO INTEGRAL GAS-COOLED NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). British Patent 1,130,329. Oct. 16, 1968. Priority date Feb. 24, 1965, Germany.

An integral gas-cooled nuclear reactor with a core and vapor generating heat exchanger contained within a pressure vessel is described. The pressure vessel contains a hood-covered core with gas coolant passing from the core to the heat exchanger. The heat exchanger consists of multiple sinuous tubes enclosing the core in an annular arrangement. Upward coolant flow is provided in the core from circulating fans beneath the core. (D.C.C.)

53313 RADIATION PROTECTION IN NUCLEAR POWER STATIONS. Bonnell, J. A. (Central Electricity Generating Board, Berkeley, Eng.). Nursing Times, 64: 278-80; 284(Mar. 1, 1968).

Radioprotection of nuclear power plant workers and the comprehensive precautions taken against irradiation hazards at English nuclear installations are described and discussed. Radiation zones in which men may be employed according to procedures specified in safety rules are defined. Routine daily radiation surveys are carried out. No individual has received a whole-body dose of external radiation greater than the maximum permissible during 5 yr of operation of 5 nuclear power stations involving the exposure of over 4000 persons. (BBB)

53314 CONTROL OF NUCLEAR POWER PLANTS. Merz, L. (Technische Hochschule, Munich). Kerntechnik, 10: 427-36 (Aug.-Sept. 1968). (In English and German).

The scope of nuclear reactor control is defined, and the start-up, shim, control and shutdown of reactors are discussed. The problems of power generation and distribution are then considered in general terms. It is shown that any desired frequency-to-power characteristic can be achieved by means of the turbine control system. Using a boiling water reactor as an example, the control of the steam flow required by the turbine is discussed. Finally, the control scheme for a modern boiling water reactor, based on the principle of bypass control of pressure, is presented in general terms. (auth)

53315 KORROZIYA KONSTRUKTSIONNYKH MATERIALOV V NATRII. (Corrosion of Construction Materials in Sodium). Nevzorov, B. A. Moscow, Atomizdat, 1968. 160p.

A unified concept of physico-chemical approach to the effects of O_2 in liquid Na on mechanisms of elementary corrosion processes, is reviewed. The experimental methods and corrosion test results of physical and chemical reactions between liquid metals and construction materials and the rate of disintegration of construction material are analyzed. The basic elementary processes of the coolant reactions with passive and oxide films (passivation or activation of construction materials in corrosion media), simple or selective solubility of solid metals (physical and chemical factors contributing to the acceleration or retardation of the process), penetration of liquid metals into solids (physical and chemical factors of frontal and intracrystal corrosion), and mass transfer of construction material components in the coolants were analyzed. (R.V.J.)

53316 PARTICIPATION BY SMALL ELECTRICAL UTILITIES IN NUCLEAR POWER. PART 2 OF 2 PARTS. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY,

CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, SECOND SESSION ON JUNE 11, 12, AND 13, 1968. Washington, D. C., Joint Committee on Atomic Energy, 1968. 629p. GPO $2.75.

Included is testimony from the public on proposed legislature bills which would allow Federal and local governmental agencies to obtain a share of the output of all nuclear plants for their own uses or for sale to small electrical utilities. (H.D.R.)

53317 AMERICAN PRACTICES IN THE DESIGN OF PRESTRESSED CONCRETE CONTAINMENT STRUCTURES. Kulka, Felix (Lin, Kulka, Yang, and Associate, San Francisco); Wahl, Howard W. J. Prestressed Concrete Inst., 13: 40-61(June 1968).

Containment structures of pressurized-water nuclear plants are surveyed. A review of the following typical parameters illustrates the magnitude of the problem in providing containment for an 800-MW(e) reactor. In addition to resisting internal pressure and temperature loads, the structure must also: provide protection of the reactor system and the leak-tight membrane against external missiles due to turbine generator failure or tornadoes; provide radiation shielding of the contained fission products following an accident; and resist external loads due to earthquakes, hurricanes, and tornadoes. After consideration of various structural systems to provide containment structures of such a magnitude, the use of post-tensioned concrete appeared to offer the best solution, because of advantages which are enumerated. Three different types of post-tensioned containment structures that are in the process of being designed and constructed in the United States are described. Some of the developments presently being considered or underway are described. (BBB)

53318 USE OF PROCESS COMPUTERS IN NUCLEAR POWER PLANTS. Haebler, D. v.; Klar, E. (Siemens A. G., Erlangen, Ger.). Kerntechnik, 10: 437-41(Aug.-Sept. 1968). (In English and German).

Process computers in nuclear power plants have to fulfill particularly high requirements with respect to storage capacity. This is due to the scope and the voluminous data store of the nuclear programs. These programs serve to monitor the conditions in the reactor core and presuppose appropriate in-core instrumentation. The evaluation of the information obtained makes it possible to operate the reactor closer to the technically permissible limits and thus to achieve a high level of utilization and availability of the plant. The programs for a pressurized water reactor are described. At present, process computers are used in Germany only for data acquisition and data processing. It may be anticipated, however, that in the future they will also be used for on-line control. (auth)

53319 FAIL-SAFE PRINCIPLE IN THE INSTRUMENTATION OF NUCLEAR POWER PLANTS. Peuster, K. (Heissdampfreaktor Betriebsgesellschaft m.b.H., Grosswelzheim, Ger.). Kerntechnik, 10: 442-9(Aug.-Sept. 1968). (In English and German).

A reactor is not only an expensive but, in case of failure, also a dangerous component of the power economy. This justifies a high outlay of planning and equipment for its protection. However, apart from the fact that safety engineers have to be instructed in reactor dynamics by nuclear physicists, and that physicists and engineers must cooperate in establishing increasing selective discriminative response criteria, there is no a priori reason for deviating from proven rules of safety engineering. Independent developments based on the fail-safe principle entail the risk that obvious, but controllable, malfunction possibilities may be replaced by inobvious but weightier dangers of malfunction. (auth)

53320 EXPERIENCE ON THE RELIABILITY OF INSTRUMENTATION AND CONTROL EQUIPMENT IN NUCLEAR POWER PLANTS. Ettemeyer, R. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen, Ger.). Kerntechnik, 10: 449-55 (Aug.-Sept. 1968). (In English and German).

The highest possible reliability of the instrumentation and control equipment can be achieved by the redundant use of reliable and simple components. Examples taken from the safety system, from the power supply to the instrumentation, and from the conventional and nuclear instrumentation and control, show how reliability can be raised. A table summarizes the experience gained with several components in the first 18 months of operation of the Gundremmingen nuclear power plant. (auth)

53321 RADIATION PROTECTION IN NUCLEAR POWER PLANTS. Wachsmann, F. (Gesellschaft fuer Strahlenforschung m.b.H., Munich). Kerntechnik, 10: 456-61(Aug.-Sept.). (In English and German).

The tasks of radiation protection in nuclear power plants are described. They include considerations on site selection and background level measurements, the control of radionuclides released into the surroundings in waste air and in waste water in normal operation and in malfunctions and accidents, the monitoring of local and of personal absorbed dose levels, and health control generally. They also include contamination measurements inside and outside of nuclear power plants, and the organisation of disaster training. Experience shows that nuclear power plants can be built with a very high level of safety, including the safety of the plant personnel and of the population at large. 21 references. (auth)

53322 DESIGN OF SHIELDINGS IN NUCLEAR POWER PLANTS. Schultz, H. (Technische Univ., Hanover). Kerntechnik, 10: 462-71(Aug.-Sept.). (In English and German).

A survey of the technological and physical aspects of shielding design for nuclear power plants is given. The differences between primary shields for reactor cores and secondary shields for radioactive cooling circuits, for the measuring and control devices, and for other service equipment, are discussed, with reference to examples of actual designs. Then the special features of shielding calculations, compared to reactor core calculations and so simple first collision calculations, are discussed. The commonly used calculation methods are described. For simple bulk shields, the methods used are either combinations of first collision calculations with build-up factors, or approximate solutions of the transport equation. For complex geometries, however, only Monte Carlo calculations are applicable in practice. Comparisons of measurements with calculated values show that even today significant discrepancies may occur and that further improvements of calculation and testing methods are needed. 23 references. (auth)

53323 NUCLEAR POWER PLANT WITH CO_2 COOLING. (to Siemens Aktiengesellschaft). British Patent 1,130,740. Oct. 16, 1968. Priority date July 9, 1966, Germany.

A description of a CO_2-cooled nuclear reactor is presented. The gas turbine and compressor are coupled and operate with CO_2 cooling gas. A flow diagram is presented for the integral heat transfer system. The reactor has a prestressed concrete vessel. (D.C.C.)

53324 IMPROVEMENTS RELATING TO HEAT EXCHANGERS. Webb, John; Taylor, Derek (to United Kingdom Atomic Energy Authority). British Patent 1,130,830. Oct. 16, 1968. Filed Feb. 25, 1966.

A heat exchanger for a liquid metal-cooled nuclear reactor is described for liquid metal and water mediums. The heat exchanger is a double-wall type with multiple panels of ladder-shaped tubes with back-and-forth flow. (D.C.C.)

53325 NUCLEAR POWER STATIONS OF THE PRESSURIZED WATER TYPE. (to Stein and Roubaix). British Patent 1,129,518. Oct. 9, 1968. Priority date Oct. 17, 1964, France.

Described is a power plant comprising a pressurized water reactor, a steam turbine, and a superheater fired by fossil fuel upstream of the turbine. A valve means is provided upstream of the superheater for controlling the pressure at the superheater inlet so that it increases with increasing load, while the pressure under which steam is raised falls. The valve means is coupled to wire-drawing valves at the turbine inlet. This arrangement allows an improvement in steam distribution in the superheater and reductions in steam entry temperature and maximum working pressure in the superheater. (H.D.R.)

53326 AN OUTLINE OF THE BWR WITH THE FUKUSHIMA ATOMIC POWER STATION AS AN EXAMPLE. Nomura, Akio (Tokyo Electric Power Co., Inc.). Sutenresu, 11: No. 12, 37-50(Dec. 1967). (In Japanese).

The BWR is described with No. 1 reactor plant of the Fukushima atomic power station as an example, in the structure of such a plant, and the materials employed, especially stainless steels, and their problems. The No. 1 reactor plant with electric output 460 MW is now under construction in Fukushima Prefecture for the start of power generation in October 1970. The description includes the following: the structure of the BWR plant (reactor and its core, cooling system, coolant-water feed system and main steam system, and other reactor devices); materials for the BWR plant and their problems (reactor, piping, etc.); and, problems of the stainless steels for the BWR plant (overlay welding of austenitic stainless steel in the reactor pressure vessel, and problems in the manufacture of large-diameter stainless steel pipes). (NSA of Japan)

53327 IMPROVEMENTS IN AND RELATING TO FUEL ELEMENT ASSEMBLIES. Robinson, John Albert (to Nuclear Power Group Ltd.). British Patent 1,130,655. Oct. 16, 1968. Filed Oct. 21, 1966.

A description of a fuel element for a gas-cooled graphite-moderated nuclear reactor is presented. The fuel elements are clad with multiple overlapping sleeves and is supported by the top sleeve. When inserted into a vertical channel the top sleeve forms a seal with the guide tube and the coolant flow exerts a force in the direction of the fuel channel axis. (D.C.C.)

53328 FUEL ASSEMBLIES FOR NUCLEAR REACTORS. Walker, Alexander (to English Electric Co., Ltd.). British Patent 1,130,633. Oct. 16, 1968. Filed Aug. 24, 1965.

A description of a fuel assembly for a gas-cooled graphite-moderated nuclear reactor is presented. The fuel assembly consists of multiple vertical fuel channels arranged around a central control rod. The fuel stack is supported from the bottom. The control rod is suspended from an overhead shield plug. (D.C.C.)

53329 DEVICE FOR SCRAMMING A REACTOR. Uematsu, Hachio (to Fuji Electric Mfg. Co., Ltd.). Japanese Patent 1968-10715. May 9, 1968. Filed Aug. 19, 1965.

The device proposed is used for scramming a gas-cooled reactor by dropping boron steel spheres into the reactor core. The advantages to the method are the increased holding of spheres in a hopper by an electromagnet, and their no-fail scram dropping into the core. It consists of the following: a cylindrical hopper; a cylindrical electromagnet within the hopper which gives a space between the hopper and itself; boron-steel spheres held in the space; a ring-shaped stopper located at the hopper bottom which is raised to the space lower end to hold spheres by the electromagnet; and a ring installed at the space lower end which moves up to the end or moves down by the electromagnet. (NSA of Japan)

53330 ANALYTIC EVALUATION OF A GAS-COOLED D_2O POWER REACTOR. Mochizuki, Hiroji (Kawasaki Dockyard Co., Ltd., Japan). FAPIG (Tokyo), No. 46, 98-109(Aug. 1967). (In Japanese).

The gas-cooled D_2O power reactor was analytically studied in Kawasaki Dockyard Co., Ltd., with the cooperation of other firms of the FAPIG. The purpose was to clarify the technological problems in order to realize its concept and to obtain necessary data for its evaluation as an advanced converter reactor. The parameter survey was carried out extensively and efforts were made to find the methods for its optimal design. As a result, the influences of various factors determining the performance of the type of reactor could be grasped. Although the analysis was confined to its characteristics in normal operation, the results of analysis showed that the gas-cooled D_2O reactor has superior properties as an advanced converter reactor. (NSA of Japan)

53331 LIQUID-METAL COOLED REACTOR. Inoue, Kotaro (to Hitachi Ltd.). Japanese Patent 1968-13713. June 10, 1968. Filed Dec. 6, 1965.

The advantages to the proposed method are the following: elimination of the danger due to a primary-coolant system rupture; simplified coolant-path heating, heat insulation, radiation shielding, etc.; and low construction cost of the reactor. It includes the following: the cylindrical reactor containment vessel; the reactor core near the bottom; a vertical cylinder extending upward from the core top; a heat exchanger for the primary liquid metal and the secondary coolant situated between the vessel wall and the cylinder wall above the reactor core; and, a reversed-flow annular linear induction pump consisting of magnet cores on the outside of the cylinder or the reactor core and the windings on the outside of the containment vessel at the positions corresponding to the magnet cores. (NSA of Japan)

53332 CONCEPTUAL DESIGN OF AN ADVANCED CONVERTER REACTOR. Anahara, Ryoji; Ando, Tetsuya (Fuji Electric Mfg. Co., Ltd., Japan). FAPIG (Tokyo), No. 46, 88-97 (Aug. 1967). (In Japanese).

As the initial step towards the development of an advanced converter reactor as a national project, orders were made by JAERI to the five atomic power industrial groups for the conceptual design of its prototype. These designs have been completed in March 1967 and the arrangement is in progress in the Power-reactor Development Promotion Hqs. The First Atomic Power Industrial Group made such a design, selecting those items specific to FAPIG. The conceptual design is described. (NSA of Japan)

53333 LARGE VALVES FOR LIQUID-METAL-COOLED REACTORS. Seim, O. S. Reactor Fuel-Process. Technol., 11: 127-37(Summer 1968).

Valve design requirements and types for liquid metal-cooled reactors are presented. A flow diagram and valve requirements for a 1000 MW(e) LMFBR are described. Problems in valve development which are discussed include: leakage, stem leakage, self-welding, hammer, size, and costs. Performances of various type valves operating in liquid metal-cooled reactors are compared. 22 references are included. (D.C.C.)

53334 TOWARD AUTOMATIC AND CONTINUOUS PLUGGING METERS. Skladzien, Stanley B. Reactor Fuel-Process. Technol., 11: 138-43(Summer 1968).

Four types of plugging-meters are described. Discontinuous and continuous automatically controlled plugging meters are also described. 12 references are included. (D.C.C.)

53335 FEDERAL REPUBLIC OF GERMANY: A SPECIAL SURVEY. Nucl. Eng., 13: 742-73(Sept. 1968).

Articles are included on research activities, the electricity supply industry, the nuclear industry, the N. S. Otto Hahn, the Grosswelzheim Laboratories, and advanced reactor technology. Separate abstracts were prepared for 6 articles. A folded chart shows the relationships between the government bodies, research facilities, reactor projects, and industrial companies. (UK)

For abstracts of individual sections see: 51151, 53336–53339, and 53485.

53336 SURVEY OF F.R.G.: SODIUM FBR PROGRAMME. Faude, D.; Seetzen, J. (Nuclear Research Centre, Karlsruhe, Ger.). Nucl. Eng., 13: 750-2(Sept. 1968).

Germany and the Benelux countries are collaborating in a joint programme of research and development directed towards the building of a 300 MW(e) prototype Na-cooled FBR. The main activities and facilities related to the programme are summarized. (UK)

53337 SURVEY OF F.R.G.: STATUS OF THTR DEVELOPMENT PROGRAMME. Schulten, R.; Hecker, R. (Nuclear Research Establishment, Juelich, Ger.). Nucl. Eng., 13: 752-5 (Sept. 1968).

The testing and operation of the pebble-bed 15 MW(e) AVR Reactor is described. The results formed the basis for the Thorium High Temperature Reactor Project which has the design of a 300 MW(e) prototype as its main objective. The prototype design is outlined, and control and fuel handling aspects are discussed. Fuel cycle costs are considered and compared with those of light-water reactors. (UK)

53338 SURVEY OF F.R.G.: THE GERMAN AGR. Marnet, C. H. (BBC, Mannheim, Ger.). Nucl. Eng., 13: 759-61(Sept. 1968).

In spite of considerable differences in the commercial structures and plant operating practice in Germany, the power station offered is, for a plant to produce electricity alone, little different from that offered in the U. K. The costs of the AGR in Germany are given, and the potential of the system as an electricity/process steam plant is discussed. (auth)

53339 SURVEY OF F.R.G.: LIGHT OR HEAVY WATER PWRs. Fewer, H.; Keller, W. (Siemens, Erlangen, Ger.). Nucl. Eng., 13: 763-7(Sept. 1968).

The Siemens PWR and PHWR designs are discussed. The main features are very similar and offer the choice of natural or enriched U. Attention is drawn to the improved fuel utilization, on-load refuelling, and larger pressure vessel of the PHWR. (UK)

53340 THE JAPC TSURUGA ATOMIC POWER STATION UNDER CONSTRUCTION TO THE HIGHEST PITCH. Sutenresu, 11: No. 12, 24-31(Dec. 1967). (In Japanese).

The Tsuruga atomic power station employs a BWR type reactor with a thermal output 970 MW and electric output 322 MW with direct cycle and forced circulation. The construction has progressed at present to the point where the dry-well for the pressure vessel has been nearly completed. The Tsuruga atomic power station under construction is described in the following: course to construction of the power station; an outline of the power plant; and, main pipings and stainless steels, including reactor-cooling systems, reactor auxiliary systems, waste-disposal systems, etc. (NSA of Japan)

53341 SURVEILLANCE OF NUCLEAR POWER PLANT COMPONENTS. Wylie, R. D. (Southwest Research Inst., San Antonio). Nucl. Eng. Design, 8: 117-24(1968).

An approach to the development of a systematic program for surveillance of nuclear reactor pressure vessels and other nuclear power plant components is described. The approach is based on a proposal developed for the LaCrosse Boiling Water Reactor (LACBWR). Specific areas treated are: the irradiation effects surveillance program; the temperature monitoring program; the inspection program; the corrosion program. (auth)

53342 HYGIENIC EVALUATION OF A NEW POWER PLANT "ARBUS-1." Arkhangelskaya, I. G.; Tsukanov, I. F. Gig., Tr. Prof. Zabol., 11: 30-4(Apr. 1967). (In Russian).

A new ARBUS-1 steam-turbine electric power installation was inspected for radiation hygiene hazards. Radiohygienic evaluation shows that nuclear reactors with organic type of moderator and coolant definitely excel reactors with other coolants as to radioprotective factors. The inspected reactor yielded a very low level of external radiation and air contamination, and this facilitated service personnel staying longer in and having easier access to the primary cycle area during operation and shortly after reactor shutdown. (BBB)

53343 IN-SERVICE INSPECTION OF DRESDEN-1. Holyoak, R. H.; Forrer, G. R.; Higgins, J. P. Nucl. News, 11: No. 11, 32-43(Nov. 1968).

An in-service inspection of the Dresden Power Reactor, Unit 1 is described. The procedures used, including nondestructive testing, to check out the reactor pressure vessel and associated piping are discussed. The inspection consisted of three stages performed by Commonwealth Edison, Babcock and Wilcox, and General Electric. Commonwealth Edison inspected pressure vessel and piping, B and W tested the vessel closure head, inlet nozzles, flange, and steam generator risers and downcomers; and General Electric inspected the welds in piping and control rod drive housing. (D.C.C.)

53344 IMPORTANCE OF PLUTONIUM RECYCLE. Hittmann, Fred; Raber, Marvin (Hittman Associates, Inc., Columbia, Md.). Nucl. News, 11: No. 11, 48-56(Nov. 1968).

The influence of Pu sale price on energy cost is illustrated by analysis of the calculated fuel cycle costs as a function of Pu price for typical 800 MW(e) boiling and pressurized-water reactors. The pertinent design characteristics and economic ground rules are summarized. A projection of Pu availability from 1968 to 1985 is presented. Developments in Pu recycle engineering and economics are described. (D.C.C.)

53345 NEUTRON RADIATION EMBRITTLEMENT OF LACROSSE REACTOR PRESSURE VESSEL STEEL AND WELDMENT: PROPERTIES AND DIRECTIONALITY CONSIDERATIONS. Serpan, Charles Z. Jr. (Naval Research Lab., Washington, D. C.). Nucl. Eng. Design, 8: 95-107(1968).

Plate sections from three heats of A302-B steel including one 4-in. thick test weldment produced for the LaCrosse Boiling Water Reactor (LACBWR) have been evaluated for both pre- and post-irradiation properties. Two of the steel heats showed exceptionally high levels of full-shear energy absorption for the longitudinal orientation, but only half those levels for the transverse orientation. The decrease in full shear energy levels as a result of 550°F irradiation were not large and appeared to be proportional between longitudinal and transverse orientations. Increases in transition temperature as a result of 550°F irradiation, 2.1×10^{19} n/cm^2 > 1 MeV, were shown to be in relation to Cu content. One heat with low Cu content displayed essentially nil embrittlement while the weld metal, containing significantly more Cu, revealed a larger amount of embrittlement. None of the LACBWR steel plates or the weldment showed as much embrittlement, however, as the A302-B reference steel which was used as the control material for the study. The three LACBWR steel heats and the weldment, thus, appear capable of accepting the lifetime neutron fluence determined for the plant without undue regard for radiation-induced property changes. (auth)

53346 THE SEFOR EXPERIMENTAL PROGRAM AND ITS INFLUENCE ON REACTOR DESIGN. Billuris, G.; Pflasterer, R.; Wolfe, B. (General Electric Co., Sunnyvale, Calif.). pp VI8.1-9 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The SEFOR project is intended to explore the operating and safety characteristics of a fast ceramic reactor with fuel materials, fuel temperatures and neutron spectrum characteristic of those expected in large fast breeder power reactors. The SEFOR experimental program places emphasis on a thorough investigation and understanding of the Doppler effect in an operating fast reactor. The Doppler effect is universally considered the keystone to fast reactor safety. Information on the Doppler effect is obtained from three different types of experiments. These are characterized as static experiments in which the reactivity effect of changing from two steady-state conditions is measured, oscillator tests in which the response of the reactor to an oscillatory change in reactivity or flow is investigated, and transient tests where the response of the reactor to rapid reactivity insertions below and above $1 is examined. The different types of tests provide complementary and some times confirmatory information on the Doppler effect such that the program, in total, provides a thorough test of our understanding of the Doppler effect under actual reactor conditions. In order to perform the experimental program outlined above, a number of requirements were placed on the reactor. These requirements influence reactor core design, reactor instrumentation, the control system, and the major plant components. In a number of cases, development programs and tests were performed to ensure that the special requirements could be met. The proposed SEFOR experimental program, the approach to analysis of the experimental data, and the various features incorporated into SEFOR to obtain high quality experimental results, and the approach planned to assure reactor safety during the transient tests are described. 19 references. (auth)

53347 QUASI STATIC MODEL FOR THE ANALYSIS OF REACTIVITY ACCIDENTS IN FAST NEUTRON REACTORS. Storrer, F. (CEN, Cadarache, France); Puig, I.; Millot, J. P. pp III5.1-10 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

It is shown that for fast reactors with a prompt negative feedback, primary reactivity accidents can be analyzed with the help of a quasi static model. For secondary reactivity accidents this model is also of interest if the mechanical dispersion occurs only after the first burst. The usefulness of this model is stressed as well for the safety as for the simplification of the accident analysis. (auth)

53348 THE CURRENT STATUS OF ANALYTICAL METHODS FOR CALCULATING THE KINETIC BEHAVIOR OF LOOSELY COUPLED FAST REACTOR CORES. Dyos, M. V.; Heck, F. M. (Westinghouse Electric Corp., Pittsburgh). pp III6.1-7 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The desire to design a fast breeder reactor which will have a limited positive Na void coefficient has led to reactor cores with large surface to mass ratios. One such design is the fast modular breeder reactor concept in which modules, consisting of a central region of fuel surrounded by annular blankets, are coupled together. In the steady state the leakage of neutrons into each module, from the adjacent modules, just balances the fraction by which the module would be subcritical if it were taken out of the array. The current status of the analytic methods for calculating the kinetic behavior of the system are considered. Detailed kinetic behavior of the fast modular reactor concept ideally requires at least a two dimensional treatment, but the computer time required would be prohibitive for the majority of design and control calculations. The very nature of the coupled system suggests that useful information can be obtained from a nodal analysis. Several nodal analyses have been given in the literature and their relative merits are discussed. The all-important problem of calculating the reactivity coupling coefficients and the methods of including a finite neutron transit time between modules are discussed in detail. A discussion is also given of the use of synthesis techniques, in particular the use of time discontinuous trial functions. 34 references. (auth)

53349 EMERGENCY CONDITIONS IN THE OPERATION OF THE BOR REACTOR. Kuznetsov, I. A.; Bagdasarov, Yu. E.; Pinkhasik, M. S.; Kazatchkovskii, O. D. (Committee on Atomic Energy, Moscow). pp III7.1-15 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

An analysis of the effects of reactivity, inlet temperature, and coolant flow perturbations on the reactor safety systems is given. Design criteria for the automatic safety system are outlined. Design characteristics of the BOR Reactor are given; these are compared with the analytical design criteria. Results of measurements of transient effects are shown graphically. (M.L.S.)

53350 INVESTIGATION ON THE BEHAVIOUR OF FISSION PRODUCTS IN SODIUM AND ARGON. PIRANA EXPERIMENTS. Saroul, J. (CEN, Cadarache, France). pp Vb1.1-10 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The PIRANA experiment was carried out essentially to study the behavior of fission products in sodium loops under conditions as close as possible to reality. Following a brief description of the experimental unit that permits the melting of irradiated uranium in 120 liters of sodium at 550°C, the main results are presented. They concern the activity distribution in a large volume of static sodium, the transmission coefficient of iodine to argon from liquid sodium, the behavior of rare gases in sodium and argon, and wall contamination. Certain problems that attempts

will be made to solve by implementation of selective experiments are emphasized. (auth)

53351 BEHAVIOUR OF FISSION PRODUCTS IN THE ATMOSPHERE SURROUNDING A SODIUM-COOLED FAST REACTOR ACCIDENTAL COOLANT FIRES. Descamps, Cl.; Rygaert, J. (Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels). pp Vb2.1-6 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

As far as safety of fast reactors is concerned, the most severe accident considered might lead to the sudden rupture at high temperature of the primary circuit. Such an accident would put Na contaminated by fission products, into contact with the atmosphere. It is important to know the various consequences of the resulting explosive reaction from the standpoint of contamination, temperature and pressure. An experimental device representing at reduced scale the conditions of accident has been set up. In the first stage of the investigation the first fission product examined was ^{131}I. During the accident simulation experiments the pressure and temperature history was measured. Furthermore, the spatial distribution of the reaction products was determined as well as the various chemical species under which the Na and ^{131}I are found after the accident. The experimental information that will be obtained successively during this study will determine the basic parameters required to design the containment for a Na cooled fast reactor meeting the conditions of safety and particularly the control of aerosols. (auth)

53352 SODIUM BURNING, AEROSOL GENERATION AND CONTROL OF FISSION PRODUCT RELEASE DURING AN ACCIDENT. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. pp Vb3.1-25 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

A discussion of experimental and analytical studies for characterising the release and transport of energy generated during a Na fire in a liquid metal fast breeder reactor is given. Experimental studies on burning rates and mass release rates are described. (M.L.S.)

53353 THE PRINCIPLE OF DOUBLE CONTAINMENT AND THE BEHAVIOUR OF AEROSOLS IN ITS RELATION TO THE SAFETY OF REACTORS WITH A HIGH PLUTONIUM INVENTORY. Haefele, W.; Heller, F.; Schikarski, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp Vb4.1-7 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Calculations are presented which show the differences in radiation burden to the environment after a serious accident of a 1000 MWe Na-cooled fast breeder if different sets of release fractions and plate-out halftimes are assumed. The feedback to various containment concepts and other engineered safeguards is discussed. (auth)

53354 SAFETY INVESTIGATIONS ON SODIUM–WATER STEAM GENERATORS. CALCULATION METHOD AND EXPERIMENTAL RESULTS. Lacroix, A. (CEN, Cadarache, France); Lions, J.; Robin, M. pp Vb5.1-23 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The consequences of a water leakage in a liquid metal heated steam generator are studied. A calculation method is proposed to obtain an approximate value of the principal parameters determinating the transient state in the steam generator and the sodium loop to which it is associated. The first results obtained on experimental steam generators are compared to theoretical results. (auth)

53355 SAFETY PROBLEMS IN THE OPERATION OF FAST REACTORS WITH THE SODIUM SEPARATED FROM THE WATER IN THE STEAM GENERATOR BY A SINGLE WALL. Poplavskii, V. M.; Blagovolin, S. M.; Aristarkhov, N. N.; Vyblov, N. F.; Bagdasarov, Yu. E.; Pinkhasik, M. S. pp Vb6.1-6 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Safety problems in the operation of Na cooled fast reactors are reviewed. Shock effects of a Na-water reaction from a leak in a steam generator are described; hydrodynamic and hydraulic effects are considered. The experimental rig used for measuring the effects of the Na-water reaction is described; data are shown graphically. (M.L.S.)

53356 THE UNITED STATES LIQUID METAL FAST BREEDER REACTOR SAFETY PROGRAM. Baker, L. Jr.; Eggen, D. T.; Ivins, R. O.; Szawlewicz, S. A. (Argonne National Lab., Ill.). pp VI1.1-8 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The objectives and status of the planning effort that is under way in the United States to develop the information required for safety analyses and evaluations of Na cooled fast breeder reactors. The program has been organized to develop capability and competence in three technical areas: the analysis of accidents and energy release, the prevention and the mitigation of the consequences of accidents, and the establishment of safety-related criteria, codes and standards. Based upon a preliminary tabulation of possible known or potential off-normal operations, instabilities and malfunctions, discipline-oriented requirements were developed to specify the research and development effort. These are expressed as a series of tasks under each of the three technical areas. A brief indication of the objectives and current efforts proceeding under each task is given. (auth)

53357 METHOD OF ASSESSING FAST REACTOR SAFETY. Farmer, F. R.; Gilby, E. V. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp VI2.1-9 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

A logical method of reactor safety assessment based upon the numerical evaluation of risk is given. The application of the method to fast reactors is discussed and this highlights the relative importance of accident prevention methods, the protective system and containment measures. The detailed discussion makes reference to some of the more important technical problems and to a number of the particular points mentioned in the programme. 9 references. (auth)

53358 SAFETY ASSESSMENT OF FAST REACTORS BY PROBABILITY METHODS. Cave, L.; Crickmer, J. R. (Atomic Power Constructions Ltd., Sutton, Eng.). pp VI3.1-6 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The use of probability methods for the assessment of safety has been developed in the U. K. for gas cooled reactors; the development of these methods has proceeded in parallel with a move towards the formulation of quantitive safety criteria. Some possible criteria are described. In particular a method has been developed which is of value for a rapid assessment of a preliminary design in order to reveal potential points of weakness before the design is finalized. The method is of general application; it is applied to the design of a 1000 MW(e) commercial fast reactor in order to illustrate the use of this method for fast reactors and also to provide a comparison, on an absolute basis, of the safety which might be achieved with gas cooled thermal reactors and Na cooled fast reactors. A difficulty in the use of probability methods at present is the scarcity of data on failure rates for structures and large items of plant. An essential feature of the method described is a perturbation of the assumed failure rates by factors of order 100, in order to assess the effect of such uncertainties. 11 references. (auth)

53359 THE COOLANT SYSTEM SAFETY OF THE REACTORS BN-350 AND BOR. Pineskii, A. A.; Bagdasorov, Yu. E.; Mitenkov, F. M.; Pinkhasik, M. S.; Pyshin, V. K. pp VI4.1-8 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Possible faults in the BN-350 and BOR nuclear plant, which might lead to interruption in the circulation of the coolant through the reactor, in the liquid metal and steam circuits are described. Features which are either theoretically practicable or are used on the plant to ensure reliable heat removal are discussed. (auth)

53360 SAFETY FEATURES OF A 300-MWe SODIUM-COOLED FAST BREEDER REACTOR (Na-2). Schlechtendahl, E. G.; Cramer, M.; Gast, K.; Heusener, G.; Merk, W.; Schikarski, W.; Schoenfeld, E.; Smidt, D. (Kernforschungszentrum, Karlsruhe, Ger.). pp VI5.1-10 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-

Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The conceptual design of the 300 MWe Na-cooled fast breeder reactor Na-2 is given. The main features of the design are described. Emphasis is on the safety related design aspects. The results of the analysis of typical reactivity insertions and coolant system failures are given. The potential consequences of severe nuclear accidents are analyzed and the containment capability of the design chosen is demonstrated. 10 references. (auth)

53361 PHENIX: MAIN SAFETY CRITERIA CONSEQUENCES FOR THE REACTOR DESIGN. Denielou, G. (CEN, Cadarache, France); Rozenholc, M.; Storrer, F.; Vautrey, L.; Villeneuve, J. pp VI6.1-6 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

As in all reactors, safety considerations have always exerted and continue to exert their influence on the design of the Phenix prototype. Examined are: the problems of permanent core cooling for the various accident hypotheses; the containment of fission products within a primary containment and the ensuing reactor building philosophy; the means for the detection of local cooling incidents by insisting particularly on reactivity and temperature measurements. In conclusion, a clear and simple evaluation of the safety system is one of the best guarantees for safety. (auth)

53362 EXPERIENCE GAINED FROM THE FINAL CONSTRUCTION PHASE AND THE APPROACH OF POWER OF RAPSODIE. Gajac, G.; Reynes, L. (CEN, Cadarache, France). pp Va5.1-12 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Problems encountered with post-neutron testing of Rapsodie are described. The effects of Na leakage and subsequent modifications are discussed. (M.L.S.)

53363 LOEFFLER CYCLE APPLICATION TO THE COOLING OF STEAM-COOLED FAST BREEDERS FROM THE POINT OF VIEW OF SAFETY. Chermanne, J.; Stievenart, M. (Belgo Nucleaire, Brussels). pp IVb1.1-7 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The steam cooled fast breeder is usually considered as a subsequent development if not as a conclusion of water reactor investigations and knowledge, and in various cases uses the same techniques. But it is above all and fundamentally a superheating reactor, which means that from the thermodynamic and hydrodynamic points of view it is rather related to gas-cooled reactors. This twofold origin accounts for the constructive characteristics related to safety which we have to consider. (auth)

53364 SAFETY CONSIDERATIONS FOR STEAM-COOLED FAST REACTORS. Hikido, K.; Rubinstein, H. J.; Sherer, D. B. (General Electric Co., Sunnyvale, Calif.). pp IVb2.1-20 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The safety considerations for steam-cooled fast reactors are in many ways different from those of Na-cooled fast reactors. The problem of the Na void reactivity and reactivity additions during operation in the latter are replaced largely by the problem of reactivity changes during flooding and unflooding of the core for maintenance or refueling. The poorer heat transfer capabilities of steam require continuity of steam flow through the core under all foreseeable conditions of component failure or pipe rupture. This continuity is made feasible by the large quantities of saturated water in the system which provides a concentrated and ready source of steam for core cooling, either upon equipment malfunction or system breaks. Many of these postulated accidents are analyzed by the FORE and other reactor dynamics digital codes. As the steam cooled fast systems under development are direct cycle systems, measures must be taken to minimize contamination of the steam turbine as a result of fuel pin failures releasing fission products to the steam coolant. The design provides inherent cleanup possibilities in the Loeffler type contact boilers in the system. Special design features are provided to reduce the amount of contaminants going to the turbine from the core. Alternate modes of operation are provided in the 50 MWe Experimental Steam Cooled Reactor (ESCR) plant if complete washing of the steam during operation should be required to keep the unit on-line until a shutdown can be scheduled. Safety considerations related to the startup and shutdown which are unique to steam cooled reactors are also discussed. (auth)

53365 SAFETY ASPECTS OF STEAM-COOLED FAST BREEDER REACTORS. Frisch, W.; Heller, F.; Huebschmann, W.; Malang, S.; Mueller, A.; Schikarski, W.; Smidt, D.; Woite, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp IVb3.1-16 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Some results on the dynamic and safety analysis of the first German 1000 MWe steam cooled fast breeder reactor design are presented. It is shown that all arising problems can be solved with today's technology, mainly taken over from boiling water reactors. The special results of the investigations presented here will be useful in the determination of new steam cooled fast reactor concepts. (auth)

53366 THE SAFETY OF STEAM-COOLED FAST REACTORS AS INFLUENCED BY THE DESIGN AND ARRANGEMENT OF THEIR COMPONENTS. Erbacher, F.; Frisch, W.; Huebschmann, W.; Ritz, L.; Woite, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp IVb4.1-15 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The dependence of dynamic behavior and safety of a steam cooled fast reactor on the design and the arrangement of the cooling cycle and its components is discussed. Design and arrangement of a selfcontrolled system is described; the consequences of certain major accidents is evaluated. Independent of any specific reactor design the criteria to achieve this are defined. (auth)

53367 CONTROL ROD CONSIDERATIONS FOR STEAM-COOLED FAST BREEDER REACTORS. Ernst, H.; Kilian, P.; Kison, H. (Allgemeine Elektricitaets-Gesellschaft, Grosswelzheim, Ger.). pp IVb5.1-8 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

A parametric study of reactor shutdown at loss of steam shows that the reactor can be shut down safely with 50 msec delay time, 2 g acceleration assuming 10 $/sec as the reactivity ramp rate of the disturbance. Various possibilities of mechanical arrangement of the control rod drives, reactor core and steam outlet plasma are discussed. A new control rod drive is proposed which is a "reversed" version of an existing drive for boiling water reactors. Both, mechanic-hydraulical and mechanical systems are discussed. (auth)

53368 DESIGN AND SAFETY OPTIMIZATIONS IN THE USE OF PLUTONIUM–URANIUM CARBIDE FUEL IN LARGE FAST BREEDER REACTORS. Sofer, G. A.; Cherry, B. H. (United Nuclear Corp., Elmsford, N. Y.). pp IVb6.1-12 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Operating characteristics of a 1000-Mw(e) Na-cooled PuC–UC reactor, consisting of neutronically uncoupled three-module core, are described and discussed; its safety characteristics are analyzed and compared to a single-module core with a L/D = 1. The influence of Na vs He as the thermal bond between fuel and cladding on the safety characteristics of both designs is evaluated. Fuel cycle cost estimates for modular and L/D = 1 designs are compared and discussed. (10 references) (auth)

53369 A REVIEW OF THE FERMI REACTOR FUEL DAMAGE INCIDENT AND A PRELIMINARY ASSESSMENT OF ITS SIGNIFICANCE TO THE DESIGN AND OPERATION OF SODIUM COOLED FAST REACTORS. McCarthy, Walter J. Jr. (Power Reactor Development Co., Monroe, Mich.); Jens, Wayne H. pp Va1.1-23 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The status of the investigation of the extent and cause of the October 5, 1966 fuel damage at the Enrico Fermi Na cooled fast breeder reactor is given as of September 13, 1967. A foreign object has been found in the core inlet plasma which is believed to have been the cause of the damage. The results of examinations of six damaged fuel subassemblies are given and some preliminary observations are made concerning possible improvements

which may be made in the design of Na cooled fast reactors to aid in the prevention, detection and recovery from similar incidents. (auth)

53370 MALFUNCTION DETECTION IN FAST REACTORS. Volk, E. R.; Jens, W. H.; Kishida, K.; Nims, J. B. (Atomic Power Development Associates, Inc., Detroit). pp Va2.1-13 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

The methods of malfunction detection in fast reactors is reviewed; equipment and operational procedures required for such systems are outlined. The proposed malfunction detection system for the Fermi Fast Breeder Reactor is described; calculational procedures used in on-line analyses are detailed. Computer and data acquisition system specifications are tabulated. (M.L.S.)

53371 RELATION BETWEEN MAXIMUM CORE COOLANT TEMPERATURES AND OUTLET THERMOCOUPLE READINGS FOR PLUGGED SUBASSEMBLIES. Friedland, Aaron J. (Atomic Power Development Associates, Inc., Detroit). pp Va3.1-13 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

Computer calculations were run for the temperature distributions in Fermi subassemblies with various degrees of plugging, for power levels below those at which sodium boiling occurs. The maximum coolant temperature occurred at the core midplane for complete flow blockage, and shifted to the top of the core for 4% or more of nominal two-loop flow through the subassembly. The ΔT to the thermocouple hole inlet was calculated to reach a maximum of about 10 times the mixed ΔT of a normal subassembly, at about 4-5% of nominal flow. With complete plugging, the ΔT to the hottest point in the core was 23 times that to the thermocouple hole inlet, and 37 times the mixed ΔT of a normal subassembly. Considerable additional temperature drop may occur in the 3-3/4-inch long channel in the handling head leading to the thermocouple. A set of generalized curves are given which can be used to estimate the ratio of outlet to maximum temperatures for a wide range of subassembly designs and operating conditions. (auth)

53372 SAFETY EXAMINATION OF THE RAPSODIE REACTOR. Fournier, J.; Ladet, J.; Puig, I. (CEN, Cadarache, France). pp VI9.1-10 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

The safety evaluation of Rapsodie has been performed taking into account the main characteristics as common to typical fast neutron sodium cooled reactors. These data are recalled and thresholds which should not be exceeded for certain parameters are defined. The accidents or malfunctions which could occur at any point of the facility are analyzed successively. This analysis shows that a generalized accident, involving the damage of all the core is altogether unlikely. On the other hand, some doubt exists regarding the consequences of a localized accident although its detection in a relatively short time is probable. Despite the great confidence placed on the functioning of the safety devices, accident calculations have mostly been performed assuming their failure; the results prove that the reactor is intrinsically very safe. Finally the evaluations of consequences of hypothetical accidents, such as secondary reactivity accidents or Na–air reactions have permitted us to show that the different safety barriers are sufficient. (auth)

53373 EXPERIMENTAL BOILING STUDIES RELATED TO FAST REACTOR SAFETY. Pinchera, G. C.; Tomassetti, G.; Gambardella, G.; Farrello, G. E. (CNEN, Casaccia, Italy). pp IVa2.1-17 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

The behavior of sodium during reactor accidents that lead to the coolant boiling in a simulated cluster of rods is evaluated. Required hydrodynamic simulation and flow diagrams for experimental sodium loops are discussed. The development of an instrumented simulated fuel rod is described. During the boiling of sodium on the surface of a vertical cylindrical heater "steady state" boiling curves and power transient liquid superheats have been measured as a function of system pressure, surface finish and history. Transient tests give very different superheat values; generally up to 10°C wall superheat for rough surfaces and up to 60°C liquid superheat for "as received" surfaces. Initial transient boiling studies in a water analog forced convection loop are described. (23 references) (auth)

53374 BOILING AND CONDENSATION OF SODIUM IN RELATION TO FAST REACTOR SAFETY. Judd, A. M. (Atomic Energy Establishment, Winfrith, Eng.). pp IVa3.1-14 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

Various aspects of Na boiling which are of importance in assessing the course and consequences of an overheating accident in a Na-cooled fast reactor are described. Bubble nucleation and the liquid superheat necessary to start vapor formation are discussed, and an approximate method of calculating the dynamics of sodium vapor bubbles is described. This is used to predict the effects when several bubbles grow simultaneously, and the results are applied to the voiding of an overheated fast reactor coolant channel to find the rates of coolant expulsion and the pressure transients involved. The condensation of vapor bubbles which move into regions of cooler liquid is also discussed, and the rates of collapse and accompanying pressure pulses are calculated. (21 references) (auth)

53375 SOME ASPECTS OF BOILING AND VAPOUR VOIDAGE GROWTH PROBLEMS IN A LIQUID-METAL-COOLED REACTOR. Kosky, P. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp IVa4.1-9 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

Theoretical studies of the initiation of boiling of a liquid metal in forced convective flow which suggest that the burn-out heat flux may be exceeded when the first vapor void is formed. This hypothesis is discussed in the light of published experimental data. It leads directly to an interest in the growth rate and configuration of vapor voids. Published asymptotic-growth-rate equations cannot be directly applied to this particular void-growth problem because of the enhanced rate of heat transfer to the evaporation interface due to the very high thermal conductivity of liquid metal. A simple model is therefore proposed to take account of this effect and calculations based on this model are given for sodium under various conditions. A satisfactory comparison is noted with the independent model of Judd in the special case in which his model is applied to the growth of a single vapor void. Experiments are then described in which the growth rate of low-pressure steam bubbles in superheated water is measured. These measurements show that the proposed void-growth model is appropriate at least to water. (21 references) (auth)

53376 AIROS-II: A REACTOR DYNAMICS SIMULATOR FOR LMFBR DESIGN. Stachura, S. J.; Blaine, R. A.; Berland, R. F.; Hausknecht, D. F. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. pp IVa5.1-9 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

Modifications to the digital kinetics code, AIROS, have been incorporated to provide capabilities for treating phase changes during transients such as coolant voiding and fuel melting based upon simplified models. The generalized nature of the feedback equations permits detailed treatment of either neutronic, thermal, or flow behavior. In addition, the running time of the code is kept quite short because of the use of a generalized Runge-Kutta method of performing the kinetics calculations and the use of interval switching. This conservation of running time is quite important to the utility of the code. An input generation routine provides a convenient input-output format which adds considerably to the feasibility of the broad application of this tool to LMFBR safety characterization. (auth)

53377 THE INFLUENCE OF A TWO-LEVEL FORMULA ON THE DOPPLER EFFECT EVALUATION FOR HOMOGENEOUS DILUTE FAST-OXIDE REACTORS. Menapace, E.; Motta, M.; Valesio, A. (CNEN, Bologna). pp IIa7.1-10 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

The results of some illustrative calculations on Doppler effect based on a two-level formula for the resonances of the fissile material are presented. In performing the calculations, the shielding effect due to one resonance of the fertile isotope has been considered. Two infinite homogeneous media having two typical

oxide-fueled core compositions were analyzed. In each case, the results obtained making use of the two-level formula, with positive and negative interference, have been compared with those obtained by applying the single level Breit-Wigner formula. (14 references) (auth)

53378 SMALL-SAMPLE SURFACE-TO-MASS AND HOMOGENEITY EFFECTS IN FAST NEUTRON SPECTRA. Carpenter, S. G.; Mountford, L. A.; Tuttle, R. J. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. pp IIa8.1-11 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Information pertaining to the variation of the reactivity worth of various samples as a function of the surface-to-mass ratios has been found to be of particular interest in fast reactor studies since it is possible to derive from such data the magnitude of the inherent reactivity effects associated with the expansion of a material as it undergoes heating. Where fissionable materials are concerned, the inherent expansion is found, over a large neutron energy range, to be considerably larger in absolute magnitude than the Doppler coefficient. Some 14 surface-to-mass ratios encompassed in cylindrical metal, oxide, and carbide samples of ^{235}U with length-to-diameter ratios varying from 32 to 1.15 were investigated in studies of this type. Other investigations have shown that, for small-sample combinations, the heterogeneous distribution of ^{235}U and ^{238}U yields the same absolute worth and Doppler coefficient as does an equivalent mass distributed uniformly throughout the same volume. These investigations were carried out in both 63-keV and 4-keV median fission energy systems. Also, in the 4-keV case, the measurement of the temperature coefficient of some 24 samples ranging from fully enriched U and Pu to mixed Pu isotopes have been performed. (auth)

53379 MODERN FAST REACTOR CROSS SECTION SYSTEMS. Yiftah, S.; Segev, M.; Lemanska, M.; Caner, M. (Israel Atomic Energy Commission, Yavne). pp IIa9.1-8 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Several classes of problems must be solved in the preparation of a group cross section set for fast reactor calculations. The first step is the evaluation of the basic nuclear data, including compilation of all available experimental information, calculations based on nuclear models to fill gaps in the data, clarification of inconsistencies and conflicting experimental information using systematics or computing weighted averages, in order to establish a complete almost point-wise scheme of the energy dependence of cross sections and other nuclear data in the energy range of interest. The second class of problems relates to the proper definition of group cross sections. When using existing group cross sections or constructing new ones, one must have a clear idea what type of group parameters are involved and exactly how their definitions as averages or integrals over products of basic nuclear data and weighting functions are given. The third problem concerns the weighting functions, which determine the group-averaging technique. Different group table types stem from different structures in the weighting functions, namely the gross structure, intermediate structure and fine structure. With the above consideration in mind, three modern group cross section sets are compared. These are the Russian 26-group set ABN, the Argonne 22-group set ANL, and the recently constructed Israeli 30-group set YSL. In the comparison, attention is paid to group structure, type of cross sections, representation and magnitude of self-shielding factors and temperature-dependence. Some typical fast reactor problems are run with the ABN and YSL sets and the results compared. (auth)

53380 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON THE SAFETY OF FAST REACTORS, AIX-EN-PROVENCE, SEPTEMBER 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967. 918p. (CONF-670916).

Sixty-eight papers were presented at the conference. A separate abstract was prepared for 65 papers. Three papers appeared previously in NSA. For abstracts of these see CONF-670916 in the Report Number Index. (R.C.K.)

For abstracts of individual papers see: 51168–51173, 52227, 53346–53379, 53381–53392, 53440–53446, 53448–53451, and 53486.

53381 ANALYSIS OF THERMAL AND HYDRAULIC BEHAVIOR OF SODIUM DURING A PROMPT POWER INSERTION IN A FUEL ASSEMBLY. Descamps, C.; Egleme, M.; Lee, J.; Michel, A. (Belgo Nucleaire, Brussels). pp I3.1-17 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

During the study and the design of an in-pile Na loop for fuel element rupture test, the fuel dispersion and subsequent Na behavior after a prompt power insertion had to be evaluated. The fuel heating, the cladding rupture, the fuel dispersion in the Na and the sudden Na boiling were studied. The work was performed for different power increase ratios and various pulse lengths. The influence of the cooling conditions was evaluated: if they have only slight effect until the moment of rupture because the fuel is heated up quasi adiabatically due to the fast power increase, they partially control the rupture itself. During very sharp power pulses, it was shown that the rupture with dispersion of fuel may happen before the melting of the fuel. The pressure following the sudden sodium boiling was evaluated. The methods obtained during this study are now being adapted to the calculation of the behavior of a fuel assembly in a fast power reactor following an incident. As a conclusion, the experimental means are described which could control the proposed theoretical model. (14 references) (auth)

53382 PROPAGATION OF FUEL MELTING IN A FAST REACTOR USING A CERAMIC FUEL. Stievenart, M.; Renard, A. (Belgo Nucleaire, Brussels). pp I4.1-15 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The code PROFUSION has been written to study the propagation of fusion in the ceramic fuel pins used in a fast reactor and the reactivity variation which can be associated with a possible fuel slumping in the axial holes resulting from the migration of porosity in the virgin fuel. The temperature distributions of the coolant, fuel can and fuel are calculated. The core power limit, i.e., the core power which initiates the fuel fusion at the hottest point of the reactor core is calculated; the propagation of fuel melting is calculated when the core power limit is overpassed. For each configuration molten fuel displacements are performed and the subsequent reactivity change is evaluated. Methods that have been used for the Enrico Fermi oxide core design and Rapsodie are discussed. (11 references) (auth)

53383 THEORETICAL STUDIES OF THE RESPONSE OF FAST REACTORS DURING SODIUM BOILING ACCIDENTS. MacFarlane, D. R.; McNeal, N.; Meneley, D. A.; Sanathanan, C. K. (Argonne National Lab., Ill.). pp I5.1-26 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The physical models and equations used to describe the kinetic behavior of a large fast power breeder reactor under Na boiling conditions are described. The models described are the Na void model, heat transfer model, neutron kinetics model, and feedback reactivity coefficients. Parameters for a reference core design are tabulated; calculated data are shown graphically. (16 references) (M.L.S.)

53384 EFFECT OF THE USE OF ^{235}U IN PLACE OF PLUTONIUM ON FAST REACTOR SAFETY. De Myttenaere, P.; Fossoul, E.; Pilate, S.; Namias, M. (Belgo Nucleaire, Brussels). pp IIa1.1-8 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

In case of use of ^{235}U in place of Pu in a fast reactor many important reactor parameters, and specially those which are related to safety, are modified. The reactor properties are very sensitive to the isotopic composition of the fuel and special emphasis is placed on the extreme cases when the ^{236}U and ^{240}Pu contents have their highest values. The ^{235}U reactor has a less positive reactivity feedback to a coolant loss. On the other hand the problems connected with the higher reactivity loss during burn-up might require important changes on the control system and on the reloading scheme. (auth)

53385 LIFE EFFECTS ON THE PERFORMANCE OF CERAMIC FAST BREEDERS. Gandini, A.; Leo, M.; Salvatores, M. (CNEN, Casaccia, Italy). pp IIa2.1-9 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The behavior of large fast ceramic reactors as a function of life is evaluated. The quantities which are considered are the Doppler effect, the sodium void coefficient and the prompt neu-

tron lifetime. Two systems are studied, representing simplified models of oxide pancake and carbide reactors. The life conditions considered represent the heavy isotope and fission product concentrations at 50,000 MWd/ton. Use is made of generalized perturbation techniques which allow a detailed analysis of the various effects which influence the performance of these systems. (auth)

53386 SAFETY ASPECTS OF PLUTONIUM-FUELLED FAST AND THERMAL REACTORS. Aloia, A.; Ariemma, A.; Buono, A.; Velona, F. (Ente Nazionale per l'Energia Elettrica, Rome). pp IIa3.1-7 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The problems associated with control and safety of fast and thermal reactors are briefly considered, with special reference to the case when Pu is used as a recycle fissile material. The phenomena which contribute to inherent reactor safety and the main design criteria are discussed. (12 references) (auth)

53387 SAFETY PROBLEMS IN THE DESIGN OF LARGE PLUTONIUM-FUELED FAST REACTORS. Leipunskii, A. I.; Kazatchkovskii, O. D.; Zizin, M. N.; Nikol'skii, R. V. (Committee of Atomic Energy, Moscow). pp IIa4.1-8 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

A theoretical analysis of the Na and Doppler coefficients for Pu-fueled fast power reactors is described. The relative safety of these reactors is evaluated. Effects of Na removal and k_{eff} are shown as a function of temperature. (M.L.S.)

53388 EVALUATION OF THE ENERGY RELEASE IN CASE OF A SEVERE ACCIDENT FOR A FAST REACTOR WITH IMPORTANT FEEDBACKS. Renard, A.; Stievenart, M. (Belgo Nucleaire, Brussels). pp III1.1-11 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The code PANIC was written to study the effects associated with a fast reactor explosion due to a step reactivity insertion. The calculation method is derived from those of Bethe-Tait and Nicholson, but is adapted to take into account an important Doppler feedback and an axial disassembly reactivity feedback rather than a spherical radial one. Comparative results are provided for the Enrico Fermi reactor, the Rapsodie reactor and a prototype of a 300 MWe Na cooled fast reactor. These results especially emphasize the influences of the Doppler effect, the reactor size and the choice of a spherical or orthocylindrical geometrical model. (auth)

53389 IMPROVEMENT IN SECOND EXCURSION CALCULATIONS. Braess, D.; Kuesters, H.; Thurnay, K. (Kernforschungszentrum, Karlsruhe, Ger.). pp III2.1-19 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The calculation of second excursions is performed mostly by a Bethe-Tait formalism. This method has been improved by some authors in different directions such as effects of delayed neutrons and of Doppler feedback. The restriction to spherical cores is abandoned and the formalism is applied to cylindrical cores. The numerical treatment is very easy, if the equation of state for UO_2 is approximated by a polynomial. Such a fit of a polynomial can be carried out to an order of accuracy far better than the knowledge of the equation of state. To have some feeling for the real equation of state of the UO_2 at high temperatures and densities, kinetic theory calculations are made about the liquid state. This calculation is based on the model of fluids proposed by H. Eyring; this model allows the construction of a partition function if the solid and gaseous state are known. The critical data and the thermodynamic functions of the liquidus are then calculated from this approximate partition function. The results obtained are compared for axial and full disassembly feedback in the spherical model. The effect of delayed Doppler feedback on released energy is discussed. Differences between cylindrical and spherical model calculations are given. (25 references) (auth)

53390 EFFECT OF CORE CONFIGURATION OF THE EXPLOSIVE YIELDS FOR LARGE SODIUM-COOLED FAST REACTORS. Lord, R. M. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp III3.1-14 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

A digital computer programme EXTRA, for the calculation of explosive yields in the Bethe-Tait type analysis of fast reactor incidents is described. Features of the programs are cylindrical geometry, the inclusion of delayed neutron effects and Doppler reactivity, a flexible representation of the equation of state for fuel, and an option to inhibit radial expansion. The program accepts the bulk of its data directly from dump tapes from the program CRAM. Results are presented for typical 1000 MW(E) systems showing the variation of yield with core L/D ratio and with the number of core enrichment zones. The influence of variations in the Doppler constant and the equation of state of the fuel, and the effect of delayed neutrons, on the energy yield is demonstrated. The influence of boundary conditions is also considered. (auth)

53391 ANALYSIS OF FAST REACTOR CORE MELTDOWN ACCIDENTS. Oyama, Akira; An, Shigehiro; Kondo, Shunsuke (Tokyo Univ.). pp III4.1-15 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Energy release during core meltdown accident is examined for a typical large fast breeder reactor using code FASTAC. The dependence of released energy upon some of the typical core parameters and meltdown area of the core is also investigated. Many works have been already performed in the field of core meltdown analysis but the change of core shape and corresponding density change have been neglected in the so-called "modified Bethe–Tait method" now generally used. The analysis of the partial meltdown phenomenon is intended in this paper. The code FASTAC is composed of one dimensional few group diffusion equation and hydrodynamic equations which govern the movement of the core material. Axial movement of core material is represented by the change of axial buckling and the effective fuel density. The meltdown phenomenon is represented by the change of core height due to gravitational force and the corresponding change of core fuel density. These treatments are approximations of the original equations, but the calculated energy releases have shown good agreement with previously calculated values by others. The dependence of released energy upon the core volume is investigated and it is found that the linear relation exists between them when the change of the prompt neutron lifetime and the power peaking factor are taken into consideration. The partial meltdown phenomenon is also analyzed varying the spatial distribution of the initial temperature of fuel material. The available energy does not show a marked decrease irrespective of the initial meltdown area. On the other hand, when the Doppler effect exists properly the available energy is nearly proportional to the initial meltdown area and the meltdown is limited to the local part of the core according to the initial condition. No dangerous autocatalytic behavior is found even in the case of the compaction of the fuel in annular region of the core. (15 references) (auth)

53392 SODIUM BOILING AND FAST REACTOR SAFETY. Peppler, W.; Schlechtendahl, E. G.; Schultheiss, G. F. (Kernforschungszentrum, Karlsruhe, Ger.). pp IIb6.1-14 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

For fast Na cooled reactor safety analysis liquid metal superheat and coolant flashing is very important. Investigation of the ejection mechanism with the digital code BLOW shows good agreement with experimental results. Present knowledge on Na superheat is reviewed and discussed in some detail, especially to demonstrate the great differences in experimental data, and from this a research program is established. Also recondensation effects with their high pressure peaks are investigated, theoretical and experimental results are presented. (26 references) (auth)

53393 NUCLEAR SAFETY. Volume 9, Number 6. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P.; Savolainen, A. W. (eds.). One of Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Nov.-Dec. 1968. 110p. GPO $0.60.

Included are 8 sections containing digests of current developments in the analysis and control of nuclear reactor hazards, operations involving fissionable materials, and the products of nuclear fission. A feature article discusses the main safety aspects of the nuclear ship Otto Hahn. Individual abstracts were prepared for the feature article and 10 of the summary articles on nuclear safety. (H.D.R.)

For abstracts of individual sections see: 51083, 51174, 51268, 53062, 53394–53396, 53404, 53452, 53487, and 53488.

53394 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. (comp.). Nucl. Safety, 9: 536-48(Nov.-Dec. 1968).

The in-process license-application records of various power reactors and data for reactors for which operating licenses have already been issued are tabulated. Proposed rule changes to Title 10 of the Code of Federal Regulations are summarized, and reports issued by the Nuclear Safety Information Center to date are listed. (H.D.R.)

53395 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Savolainen, A. W.; Whetsel, H. B. (eds.). Nucl. Safety, 9: 525-33(Nov.-Dec. 1968).

Abstracts are presented of the projects sponsored by the AEC Division of Reactor Development and Technology on various aspects of fast reactor safety, gas-cooled reactor safety, effluent control, and general nuclear safety studies. Topical and progress reports are listed for each project. (H.D.R.)

53396 FISSION-PRODUCT RELEASE AND TRANSPORT IN LIQUID-METAL-COOLED FAST BREEDER REACTORS. Keilholtz, G. W.; Battle, G. C. Jr. Nucl. Safety, 9: 494-509(Nov.-Dec. 1968).

Liquid-metal-cooled fast breeder reactors will build up large fission-product inventories. Volatile fission products may be vented from the fuel elements to the primary Na coolant. In operation and after minor meltdowns, the coolant system will retain most of the ^{131}I and other fission products from vented or ruptured fuel elements; some, particularly noble gases, will enter the Ar blanket gas. If the coolant system and the N_2 filled containment system enclosing it were breached, Na containing ^{24}Na, fission products, and possibly UO_2 and PuO_2 would enter the air within the secondary containment system. The Na would burn, and Na_2O aerosols might sorb or occlude large fractions of most radioactive materials but not of the noble gases. High-efficiency particulate-air filter systems for water-cooled reactors may be readily adaptable for the removal of Na_2O aerosols by the addition of extensive prefiltering systems. Methyl iodide may not be a problem in these reactors. The major hazards will probably be ^{24}Na, Pu, fine aerosols, and noble gases. 53 references. (auth)

Marine and Portable Power Reactors

Refer also to abstract 52305.

53397 (AN-AGCR-959) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. FUEL PIN TUBING CONTROL TESTS. (Aerojet-General Nucleonics, San Ramon, Calif.). Nov. 1965. Contract AT(10-1)-880. 25p. Dep. CFSTI.

Specimens of Hastelloy X tubing used in the fabrication of the IB-17R (ML-1 second core prototype) test elements are exposed to conditions simulating 1179, 5820, and 10,000 hr operations at 1300, 1450, 1600, 1750, and 1800°F. Specimens are evaluated by tensile testing and metallography. (auth)

53398 GAMMA-RAY LEAKAGE THROUGH A SLIT IN LEAD SHIELD. II. Miyasaka, Shun-ichi (Japan Atomic Energy Research Inst., Tokyo); Kanemori, Yoshihiko; Fukushima, Yutaka; Yamada, Takeshi. Nippon Genshiryoku Gakkaishi, 10: 488-95 (Sept. 1968). (In Japanese).

In continuation of a series of mockup tests for the first Japanese nuclear ship, reactor γ-ray leakage through a double-bend two-dimensional passage in a lead slab is experimentally studied. This zig-zag slit channel is recognized to be an effective device against γ-ray leakage at shield seams. Such leakage may occur through straight passages with normally incident γ-rays, or else with oblique incidence, in the form of streaming. In the case of zig-zag channel, it should be noted that there exist certain incident angles at which the shielding effect is markedly impaired. The components of penetration calculated by ray-analysis method are compared with experimental results. The existence of a slit in a lead slab increases scattered γ-rays, which are localized near the shield surface, but which spread widely with increasing distance from wall. (auth)

53399 NEUTRON PHYSICS RESEARCH FOR DESIGNING THE "NERO". Coehoorn, J. Atoomenergie Haar Toepass., 10: 172-88(1968). (In Dutch).

The research program carried out at the Reactor Center is described, reviewing studies on the physics of light-water reactors, experimental techniques and potential applications for future projects. The core design of the NERO project is outlined: this involves a small, pressurized-water reactor, operating on slightly enriched fuel and suitable for maritime propulsion. The design calls for an output of 63 MW, a water temperature of 296°C, a period of 1100 days between fuel changes, a heat flux of <40 w/cm, and grains of fissionable neutron poison embedded in the fuel. Calculations and experiments relating to alternate core designs are also mentioned. It is proposed to construct a prototype reactor, in order to verify the behavior of the neutron poison under actual operational conditions. The results obtained thus far may be used for building a land-based reactor. (TTT)

53400 SAFETY ASPECTS RELATING TO THE START-UP OF THE REACTOR FOR THE NUCLEAR RESEARCH SHIP "OTTO HAHN". Gielen, H. (Internationale Atomreaktorbau G.m.b.H., Bensberg, Ger.). Kerntechnik, 10: 472-7(Aug.-Sept. 1968). (In English and German).

The reactor start-up process is examined, and a description is given of the provisions by which damage to the core as a result of an improper start-up can be precluded with certainty. (auth)

53401 CHARACTERIZATION OF THE FRACTURE SURFACE OF THE PM-2A PRESSURE VESSEL. Beeston, J. M. (Idaho Nuclear Corp., Idaho Falls). Nucl. Eng. Design, 8: 83-94(1968).

The reactor vessel of the Army Portable Medium Power Plant, PM-2A, embrittled by in-service irradiation, was tested to destruction under a set of defined conditions including an intentionally installed material defect. A brittle fracture was achieved which initiated at the defect. The post-test examination of the fracture surface, including the artificial defect, characterized the fracture as essentially brittle with an estimate of at least 90% cleavage in the region of rapid running fracture. Four distinct regions were observed: a shear lip in the A350-LF3 steel on the outside edge of the vessel, more pronounced in lower fluence regions, but with a minimum height and width of 0.1 in. in the high fluence region (4×10^{18} nvt); the stainless weld deposit; the stress corrosion region which started at the artificial defect and extended 0.2 in. into the steel; and the region of flat running crack which extended from the crack origin to the top and bottom closure flange and exhibited principally quasi-cleavage. (auth)

53402 CRITIQUE OF IN-PLACE ANNEALING OF SM-1A NUCLEAR REACTOR VESSEL. Potapovs, Uldis (Naval Research Lab., Washington, D. C.); Knighton, George W.; Denton, Arthur S. Nucl. Eng. Design, 8: 39-57(1968).

The annealing procedure used by the US Army Engineer Reactors Group (USAERG) to extend the SM-1A reactor vessel lifetime, which was essentially expanded due to neutron-induce embrittlement, is described. In August 1967, vessel annealing operations were conducted by raising the system temperature to 572°F and maintaining it for 143 hr using the normal reactor core as the heat source. The procedures used, plant modifications required, and difficulties encountered are described, and a full critique of the total operation is given. Discussions include the anticipated amount of embrittlement relief to the vessel, the basis for this estimate, and the techniques for establishing the degree of final properties recovery. (auth)

53403 PM-2A REACTOR VESSEL TEST: ANALYSIS OF FAILURE CONDITIONS. Walker, T. J. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Eng. Design, 8: 71-82(1968).

The reactor vessel of the Army Portable Medium Power Plant, PM-2A, embrittled by in-service irradiation, was tested to destruction under a set of defined conditions including an intentionally installed material defect. The purpose of the test was to improve the understanding of conditions required to obtain brittle fracture in an operating reactor vessel and to establish improved criteria for use in reactor vessel design and operation. The test consisted of a prescribed pressure-temperature sequencing procedure with a series of defects of increasing size in the vessel wall to assure fracture at a lower bound condition. A brittle fracture was achieved which initiated at the defect with an internal vessel pressure of 4475 psig and a temperature of -20°F. The failure conditions are analyzed on the basis of fracture mechanics utilizing material properties of the irradiated material. These properties were determined by post-test measurements from specimens cut from the vessel wall adjacent to the installed defect. This defect (EDM machined) lacked sufficient notch acuity to initiate fracture within the charging system capability and was sharpened with a strain etching technique. An evaluation of this technique, including experimental results, provides confidence in the analysis of the failure conditions. Post-test and earlier predicted results, based on extrapolations of data for irradiated materials, are compared. (auth)

53404 SAFETY-DESIGN ASPECTS OF NUCLEAR-POWERED SHIP OTTO HAHN. Wiebe, W. (Gesellschaft fuer Kernenergieverwertung im Schiffbau und Schiffahrt, Geesthacht, Ger.); Ulken, D.; Salander, C.; Henning, K. Nucl. Safety, 9: 443-56(Nov.-Dec. 1968).

The design and construction of the Otto Hahn are described, and the main safety features of the ship and the reactor plant are discussed, including design, testing, acceptance, and training procedures. Described are: the hull and machinery, the reactor components and systems, reactor testing and dynamic behavior,

the design-basis accident, port operations, personnel training, and testing and trials programs. 25 references. (H.D.R.)

Rocket and Space Reactors

Refer also to abstracts 51569 and 53431.

53405 WHEN TO GIVE A DESIGN A SECOND LOOK: A PHILOSOPHY OF REEXAMINATION. Evvard, John C. (Massachusetts Inst. of Tech., Cambridge). Astronaut. Aeronaut., 6: 56-69(Aug. 1968).

Re-examination of design concepts is exemplified by a discussion of the open-cycle gaseous-core nuclear rocket and of thermionic converters. A pessimistic re-examination toward development of the open-cycle gas-core nuclear rocket is presented. Thermionics as an attractive way to generate space power is considered. If the heat source is nuclear, a thermionic system could have the diode either in or out of the pile. The out-of-pile arrangement would be simpler to develop. However, it would need a circulating-fluid heat-transfer system to carry the nuclear-generated heat from the reactor to the combined or separate radiator and diode array. The conceptual design of an out-of-pile radial heat pipe thermionic reactor system using ^{233}U is shown. (BBB)

53406 HOW TO USE QUASI-LINEAR PROGRAMMING FOR CALCULATING OPTIMUM REACTOR CONTROL. Price, H. J.; Mohler, R. R. (Univ. of New Mexico, Albuquerque). Reactor Fuel-Process. Technol., 11: 123-6(Summer 1968).

A recursive algorithm is developed from a sequence of linear-programming problems to handle nonlinear reactor problems. Then a coolant-optimal-control process is computed for a nonlinear nuclear rocket reactor. (auth)

53407 ROCKET PROPULSION. Vogel, Jack M. Space/Aeronaut., 50: 53-8(July 31, 1968).

Development of nuclear rockets, as well as liquid- and solid-propellant fueled types, hybrid, and electric types, is reviewed. (BBB)

53408 SURVEY OF ADVANCED CONCEPTS IN NUCLEAR PROPULSION. McLafferty, G. H. (United Aircraft Research Labs., East Hartford). J. Spacecraft Rockets, 5: 1121-8(Oct. 1968).

A brief review of gaseous nuclear rocket engine concepts is presented. Engine configurations and performances are described. Heat transfer and fluid mechanics for possible operational systems are analyzed. (91 references) (D.C.C.)

Process Heat and Desalination Reactors

53409 (ORNL-NDIC-4) INDEXED BIBLIOGRAPHY OF NUCLEAR DESALINATION LITERATURE-2. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 65p. Dep. CFSTI.

Abstracts are given for approximately 240 published articles related to the desalination of seawater. The body of the report is a copy of information stored in a computerized storage and retrieval system for the Nuclear Desalination Information Center (NDIC) at the Oak Ridge National Laboratory. The abstracts are grouped in nine categories (and repeated if they fall into more than one category). An author and a keyword index to the articles referenced is provided. The keywords, which identify the content of the articles, were chosen from a thesaurus developed by NDIC. (auth)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 51162, 51174, 51276, 51279, 51284, 52127, 53359, and 53454.

53410 (AD-669685) BULK SHIELD FACILITY IRRADIATION ACCOMMODATIONS AT THE AIR FORCE NUCLEAR ENGINEERING TEST FACILITY. Vallish, E. J. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). June 1966. 40p. (AFIT-TR-66-9). CFSTI.

Irradiation facilities available to engineers and scientists for research and development, engineering and applied testing, and technological applications in various scientific fields are described. (TSS) (USGRDR)

53411 (BNWL-819) CALCULATIONS OF VACANCY CLUSTER PRODUCTION IN IRON FOR EBR-II, DFR, FTR, AND ETR. Russcher, G. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 22p. Dep. CFSTI.

Calculations of the interactions between neutrons and Type 304 and Type 316 stainless steels and iron are made by use of SPECTRA computer programs. The calculations are performed for the FTR, DFR, EBR-II, and the ETR. (D.C.C.)

53412 (DUN-SA-55) CALCULATIONS OF PHYSICS PARAMETERS FOR MIXED FUEL-TARGET LATTICES. Agee, L. J. (Douglas United Nuclear, Inc., Richland, Wash.). Feb. 1, 1968. Contract AT(45-1)-1857. 7p. (CONF-680601-41). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

The ability to consistently predict the behavior of a wide variety of fuel-target mixed lattices using different combinations of computer codes is studied. Four representative sets of lattice physics parameter measurements in the Physical Constants Test Reactor are presented. Three different methods of combining the HAMMER and EXTERMINATOR-2 computer codes are compared. (D.C.C.)

53413 (EUR-4060) AMPLIFICATION OF VIBRATIONS DUE TO THE REPETITION OF THERMAL SHOCKS IN A PULSED FAST REACTOR. Randles, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1968. 33p. Dep.

A method of evaluating the amplification of fuel slug vibrations caused by the fast repetition of thermal shocks during the normal operation of a pulsed fast reactor is described. Such a method is required primarily for the assessment of fuel element safety. From a study of the response of a fuel slug to a discontinuous temperature rise, it is concluded that only the fundamental mode axial vibrations generated during a pulse can survive long enough to interact with the vibrations generated by the next pulse. The theory of amplification is therefore developed on the basis of the fundamental mode alone. The problem is essentially that of studying the interference between an existing wave (the cumulative product of all previous pulses) and the wave suddenly introduced at a given moment by the latest pulse. A recurrence formula relating the amplitude of vibration at any two consecutive pulses is derived. This equation is solved in two ways. First, the asymptotic solution (representing steady oscillatory equilibrium with the imposed pulse train) is obtained analytically and found to possess the expected resonances for pulsation periods equal to integral multiples of the (fundamental mode) period of oscillation. Second, the detailed solution describing the pulse-by-pulse approach of the vibrations to their asymptotic level is obtained numerically. Simple approximate formulae giving the height and half-width of the resonances and the timescale of all transients are derived and should prove useful in design studies. (auth)

53414 (GA-8805) LATTICE PHYSICS STUDIES. Quarterly Progress Report for the Period Ending June 30, 1968. Trimble, G. D.; Gozani, T.; Neill, J. M.; Preskitt, C. A. (Gulf General Atomic, Inc., San Diego, Calif.). July 22, 1968. Contract AT(04-3)-167. 64p. (EURAEC-2068). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Thermal neutron spectra are measured at seven spatial positions across the central cell of a 1.0 in. triangular pitch U rod lattice. The measurements are performed at the Lattice Experiment Facility. The techniques used to measure neutron spectra in lattices are described. The program being developed to measure the thermal neutron spectrum in $Pu(NO_3)_4$ solutions is described. (D.C.C.)

53415 (IN-1158) ISOTHERMAL HYDRAULIC MEASUREMENTS IN FUEL ELEMENTS IN ATR CORE. Griebenow, M. L. (Idaho Nuclear Corp., Idaho Falls). Sept. 1968. Contract AT(10-1)-1230. 171p. Dep. CFSTI.

Descriptions of the ATR core and fuel element configurations are presented. The results from isothermal hydraulics tests of the ATR fuel assemblies are discussed. The fuel assemblies were instrumented to measure the coolant flow rate and both axial and lateral pressure gradients within the reactor. (D.C.C.)

53416 (LA-4009) ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX). Quarterly Status Report for Period Ending July 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Aug. 1968. Contract W-7405-eng-36. 16p. Dep. CFSTI.

LOS ALAMOS TURRET REACTOR—reactivity effects in, measurement of effects of variation in coolant pressure and flow rate on; reactivity of, measurement of temperature coefficient of; startup procedures for, development of; fuel elements for, absolute fission rate measurements in; fuel elements for, testing of thin layer pyrocarbon for

corrosion protection of; power calibration of; reactivity of, effects of helium coolant pressure at room temperature on; coolant flow control system for, performance of digital computer; core moderator for, measurement of isothermal coefficient of reactivity for; reflector for, measurement of isothermal coefficient of reactivity for; effluent stack monitor for, effects of DOP testing of

REACTOR FUEL ELEMENTS—neutron fission rates in UHTREX, measurement of absolute; corrosion protection of UHTREX, testing of thin layer pyrocarbon for; neutron fission energy profiles for UHTREX; temperature of UHTREX, description of melt-method for measuring; thermal properties of coated particle

REACTOR CONTROL ELEMENTS—position indication for UHTREX, development of methods for; calibration of UHTREX

REACTIVITY—effects of UHTREX coolant pressure and flow rate variations, measurement of

COMPUTERS—performance of UHTREX helium coolant flow control digital

RADIATION MONITORING—performance of UHTREX stack and annunciator panel (M.L.S.)

53417 (LA-DC-9370) MEASUREMENT OF THE CRITICAL MASS OF A WATER-REFLECTED PLUTONIUM SPHERE. Geer, W. U.; Smith, David R. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 3p. (CONF-680601-39). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

Criticality measurements for a water-reflected Pu sphere are presented. The high purity plutonium was fabricated and machined into a mass of 5546 g. The sphere was coated with Cu and enclosed in a Plexiglass shell. Monitoring of the neutron counting rate due to the Pu provided frequent checks of the multiplication of the sphere as water was slowly added to the sphere-containing 4 × 4 ft tank. One-dimensional DTF calculations are presented. The sphere was remachined to remove 200 g and the water-adding procedure repeated. Results are discussed. (D.C.C.)

53418 (ORNL-4268) DEVELOPMENT AND FABRICATION OF INSTRUMENTED-PLATE ADVANCED TEST REACTOR FUEL ELEMENTS. Erwin, J. H.; Werner, W. J.; Martin, M. M. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 103p. Dep. CFSTI.

A procedure was developed for manufacturing instrumented advanced test reactor fuel elements. The full-size assemblies are unique in that they contain one or two double-core fuel plates, which eliminate the intervening water channel to provide thermocouple wells for in-reactor temperature measurements. The two cores are replicas of the replaced standard core fabricated into a single 0.178-in.-thick plate to provide internal temperature measurement at 5 to 16 separate locations. Deviations from normal ATR fuel-element processing comprise solid-state reaction to prepare stoichiometric UAl_3, roll bonding of dual-cored plates, and malforming in compression. During fabrication development, noteworthy differences in the fabricability of U_3O_8- and UAl_3-bearing plates of equivalent U loading and geometry were observed. When compared to U_3O_8, the UAl_3-Al dispersion showed excessive growth during vacuum anneals, severe thickening or dog-boning near the core ends, and separation of tandem cores in rolling. (auth)

53419 (ORNL-TM-2338) BULK SHIELDING FACILITY QUARTERLY REPORT, APRIL–JUNE OF 1968. Tabor, W. H. (comp.) (Oak Ridge National Lab., Tenn.). Aug. 8, 1968. Contract W-7405-eng-26. 21p. Dep. CFSTI.

The BSR was operated for 705.4 hr and produced 1,296,943 kwh of energy. The major portion of this operation was for basic research. The PCA was operated during April to conduct experiments for the University of Tennessee and for the training of personnel of the Tennessee Valley Authority and ORNL. Maintenance during April to June 1968 is described. (auth)

53420 (ORNL-TM-2340) OPERATING MANUAL FOR THE POOL CRITICAL ASSEMBLY (PCA). Costner, R. A. Jr.; Tabor, W. H. (Oak Ridge National Lab., Tenn.). Aug. 23, 1968. Contract W-7405-eng-26. 135p. Dep. CFSTI.

A description of the PCA configuration and instrumentation is presented. Operating procedures are described. Emergency procedures are also described. (D.C.C.)

53421 (PINSTECH/HP-5) ESTIMATION OF GAMMA FLUX AT THE THERMAL COLUMN OF PAKISTAN RESEARCH REACTOR. Ali, Anwar; Ahmed, Syed Mansoor; Mubarak, M. A. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Health Physics Div.). 1968. 10p. Dep.

The thermal column of the Pakistan Research Reactor is described; the methods used in measurement of the γ dose rates are described. Results of dose measurements at power levels of 100 watts, 1, 10, and 100 KW, and 1 and 4 MW are tabulated. γ ray intensity resulting from thermal neutron radiative capture in Al, Pb, B, and C is tabulated as a function of energy. The γ dose rate at the face of the thermal column and the γ spectrum are shown graphically. (M.L.S.)

53422 (WCAP-3269-61A) IN-PILE SWELLING OF UO_2 FUELS. ETR TESTS OF HIGHLY RATE UO_2 FUEL SAMPLES. Kubit, C. J.; Rose, R. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). [nd]. Contract AT(30-1)-3269. 93p. Dep. CFSTI.

The experiment is designed to obtain basic irradiation data which can be used to establish fuel swelling correlations for cylindrical UO_2 fuels. The design parameters specified for the experiment are summarized. Unexpectedly high flux levels in the test positions used in these ETR tests resulted in fuel melting and produced a sufficiently large number of cladding failures to severely compromise the ability of the experiment to yield a useful fuel swelling correlation. The test program was discontinued at this point, since consideration of the effect of existing failures in combination with the likelihood of other test pins having sustained some damage led to the conclusion that the attainment of significant UO_2 fuel performance data was highly unlikely. The evaluation of the failed test pins and the failure analyses leading to the decision to terminate the test are described. (auth)

53423 (Y-DR-2) REMARKS ON ARRAY CRITICALITY TECHNIQUES. Thomas, J. T. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Sept. 20, 1968. Contract W-7405-eng-26. 23p. Dep. CFSTI.

The problem of establishing the critical parameters for an array of arbitrary units of fissile materials is analyzed. The techniques described characterize a mass of fissile material by its multiplication factor. A critical assembly of N units of spherical masses in cubic cells is determined by adjusting the spacing of the units such that the correct interchange of leakage neutrons will occur between units and the correct fraction lost from the array. Two critical arrays of differing numbers, N, for a given unit establish the fraction of neutrons that must be lost from the arrays or the total fraction of neutrons that must remain in the array to maintain criticality. The NB_N^2 method may then be employed to specify criticality at other N values and therefore complete the characterization of critical arrays for the unit. Examples are presented. 7 references. (auth)

53424 CONTENT OF ^{18}F IN COOLING WATER OF THE NUCLEAR RESEARCH REACTORS. Nikolov, K.; Kulev, I. At. Energ. (USSR), 25: 184-7(Sept. 1968). (In Russian).

The accumulation of radioisotopes depending on the time of irradiation has been established. The approximate value of the saturated activity of ^{18}F in the water of the primary circuit of the nuclear reactor IRT-1000 (Sofia) has been calculated. ^{18}F is produced by the nuclear reaction $^{18}O(p,n)^{18}F$. The presence of the ^{18}F in the cooling water has been proved by precipitating it on an isotope-carrier, by half-life measurement, and by recording the γ-spectrum by a multi-channel pulse analyser. It has been proved that the precipitation of the ^{18}F as PbCl ^{18}F from the water of the primary circuit of the reactor is usually accompanied by a coprecipitation of some radioisotopes which are present in the water. (auth)

53425 NEUTRON PROPAGATION IN URANIUM DIOXIDE. PART I. SPACE-ENERGETIC DISTRIBUTIONS OF NEUTRONS. Golubev, V. I.; Golyaev, N. D.; Zvonarev, A. V.; Zizin, M. N.; Koleganov, Yu. F.; Nikolaev, M. N.; Orlov, M. Yu. At. Energ. (USSR), 25: 292-7(1968). (In Russian).

The experimental results of the neutron induced reaction velocities in a large block of UO_2 (dioxide reflector of BR-I reactor) are presented. The neutron spectrum in the large UO_2 block is investigated by the time-of-flight method and sandvich technique. The results of the measurements are compared with the calculations of the neutron propagation in UO_2 by 26-group set of constants. The results give the possibility to estimate the accuracy of the set of constants and calculation methods. (auth)

53426 INSTRUMENTATION FOR A REACTOR EXPERIMENT. Preussner, A. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 10: 484-93(Aug.-Sept. 1968). (In English and German).

An experimental arrangement for reactor experiments consists of an in-pile rig, a circulation system, and instrumentation. The latter includes the entire measuring, regulating, control and safety systems. It is shown on an example how these systems are laid out starting from the requirements imposed by the experiment, and by the service and safety conditions, and how the circulation

system and the in-pile rig are retroactively defined from the control and the safety points of view. It is described how, on the basis of a malfunction analysis, safety parameters are chosen which are adequate for setting off the necessary safety measures. These considerations finally result in a block diagram for the instrumentation, from which the groups, components, and individual elements can be derived for purposes of design and fabrication. 4 references. (auth)

53427 IN-PILE RADIATION LOOPS. Mihaila, A. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 20: 221-30 (1968). (In Rumanian).

A number of reactor technology problems must be solved before the main design features of a new reactor can be determined. The necessary information concerning the characteristics of the fuel elements, cladding materials, coolant, structural components, chemical compatibility of the system and their behavior in a neutron or γ flux must be obtained by loop experiments. In-pile loops, passing through the core, are used primarily to study coolant problems, such as radiation stability of the cooling agent, the nature of the dissociation or radiolytic products, effect of radiation on the corrosion rate, etc. "Hot" loops are also used to investigate the behavior of fuel elements. Heat transfer calculations are often verified by loop tests which are also used to evaluate the behavior of fission products in case of rupture of the cladding, enabling the designer to ensure the safety of the system by taking suitable preventive steps. (Review article, 8 references). (TTT)

53428 IN-PILE FLOW TYPE GAS REACTION EQUIPMENT. Nonaka, Kozo (Tokyo Atomic Energy Industries Research Lab., Ltd.); Doi, Akira. Hitachi Hyoron, 50: No. 2, 1-5(Feb. 1968). (In Japanese).

With a view to utilizing mixed neutrons and γ rays in a reactor for chemical reactions, the in-pile flow type gas reaction equipment was installed in the HTR; and, the effect of reactor radiations in the catalytic hydrogen addition reaction for ethylene was examined. In the design and construction of the equipment, full consideration was taken for its safety with regard to reactor, reacting gases and radiation. Micro-oxygen content analyzers, safety valves, etc., are installed for prevention of any explosions. Some features of the equipment are: pressure 26 atm, temperature 350°C, gas flow-rate 4 to 750 l/h (NTP), with the temperature and flow rate being controlled within ±1% and ±3% respectively. In the hydrogen addition reaction for ethylene with ZnO etc., as the catalyst, the change in catalytic activation by the irradiation is possibly caused by the fast neutrons. (NSA of Japan)

53429 DEVICE FOR CONVEYING A NEUTRON SOURCE. Yoshikawa, Hideo (to Mitsubishi Atomic Power Industry Inc.). Japanese Patent 1968-13718. June 10, 1968. Filed May 13, 1965.

The device proposed is for conveying a neutron source in connection with the operation of an experimental reactor. The advantages are the following: the remote handling thereby eliminating the exposure of the operator to radiations; and, the absolute and simple conveyance. The reactor core is placed at the bottom of a water pool. The device consists of the following: a conveyor pipe extending from above the pool through the pool water to the vicinity of the reactor core; a short pipe connected to the vertical pipe where a radiation source is temporarily held; a device for moving the source in the short pipe with respect to the reactor core; and a device for supplying water from the pool to the conveyor pipe for conveying a radiation source. (NSA of Japan)

53430 LOW TEMPERATURE IN-PILE IRRADIATION FACILITIES. Nakai, Yasushi (Mitsubishi Atomic Power Industries, Inc., Japan); Akashi, Katsuhiro Reito (Tokyo), 43: 798-805(Aug. 1968). (In Japanese).

A study of radiation damage of neutrons to various kinds of metal at very low temperature is very important research for the prediction of the behavior of materials for nuclear reactors. Low temperature in-pile-irradiation facilities (called LHTL), which are the fourth installation in the world, were set up in a research reactor of the Japan Atomic Energy Research Institute. The facilities comprise a closed type helium liquefier system having refrigerating capacity of 50W, a cryogenic irradiation tube to irradiate test specimen with fast neutrons in liquid helium temperature environment and specimen handling equipment for removing the sample pieces held at very low temperature. They were built by Cryogenic Engineering of Mitsubishi. The construction and functions of the principal parts and a brief report on the erection at the site are presented. (auth) (NSA of Japan)

53431 REACTOR AND FUEL-PROCESSING TECHNOLOGY. Volume 11, Number 3. Dutton, James J.; Lennox, David H.; Royal, Joseph; Gold, Raymond. One of the Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Argonne, Ill., Argonne National Lab., Summer 1968. 52p. GPO $0.70.

Nine articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 51061–51064, 53333, 53334, 53406, 53432, and 53433.

53432 A REVIEW OF THE EXPERIMENTAL AND ANALYTICAL RESULTS OF THE HIGH-CONVERSION CRITICAL EXPERIMENT. Plumlee, Karl E.; Pennington, Edwin M. Reactor Fuel-Process. Technol., 11: 117-20(Summer 1968).

Criticality calculations and experiments for enriched UO_2-fueled water-moderated core are presented. The fuel elements consist of Type 304 stainless steel- and Al-clad pellet-shaped UO_2. Calculations for various geometry BORAX-5 and Hi-C cores are presented. (D.C.C.)

53433 REVIEW OF RESULTS OF THE DIMPLE CRITICAL EXPERIMENT. Plumlee, Karl E. Reactor Fuel-Process. Technol., 11: 121-2(Summer 1968).

Physics measurements for four different cores in the DIMPLE critical assembly are presented. The cores consist of Hi-C pellet-type enriched UO_2 fuel elements with Type 304 stainless steel and aluminum cladding. The assemblies are water-moderated. (D.C.C.)

53434 NUCLEAR REACTOR. Nakai, Yasushi (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1968-13716. June 10, 1968. Filed Aug. 19, 1964.

The semi-homogeneous nuclear reactor includes the reactor core, the inner and outer reflectors surrounding the core, and vertical experimental holes located at the boundary between the inner and outer shields. When irradiation is made in the vertical holes, the thermal neutron flux distribution in the radial direction within the hole can be flattened. In performing irradiations in the hole, part or all of the inner reflector or moderator is removed to increase the neutron flux in the hole. (NSA of Japan)

53435 RABBIT DEVICE FOR A REACTOR. Ogawa, Hiromi (to Nippon Atomic Industry Group Co., Ltd.). Japanese Patent 1968-10717. May 9, 1968. Filed July 6, 1965.

By the method proposed, samples in rabbits can be irradiated in a sequence one after another without stopping the fluid flow in the path thereby cooling samples while in the path. It consists of the following: a vertical path into which a rabbit is inserted from the upper end and drops down by gravitation; a horizontal path at a certain position of which the vertical path joins it (the path leads to the reactor core at one end, and at the other end a rabbit is taken out); a sphere which constitutes the joint of the two paths; a rotating spherical body with a hole penetrating the body through the center installed in the spherical space; a bypass path running from one point to another of the horizontal path with the spherical space between; and a valve in the bypass. When one rabbit is in the hole vertically positioned and another rabbit from the reactor core is in the horizontal path at a position ahead of the sphere joint, the valve in the bypass is opened thereby permitting the flow of liquid. (NSA of Japan)

53436 DEVICE FOR HANDLING RADIOISOTOPES. Aizu, Tadashi (to Hitachi Ltd.). Japanese Patent 1968-10720. May 9, 1968. Filed Jan. 23, 1965.

By the method proposed, the sending of a material into a pneumatic tube which goes to reactor core, its withdrawal and storage from the tube, and the placement and taking-out of a material with respect to the device are all done in a single unit of the device; the over-all procedure is simplified and the space for its installation is small. It consists of the following: the upper and lower shields joined together; a horizontal, rotating thick disc with vertical holes circumferentially installed within the joined shields; a pipe connecting to the hole and leading to the pneumatic tube which runs from the top of the hole through the upper shield; a pipe connected to the bottom of the hole running through the lower shield which supplies pneumatic-tube air; a shielded container located just below the hole on the opposite side to the side of the two pipes of the rotating disc which receives an irradiated material; and, a pipe connected to the top of the hole on the opposite side of the disc running through the upper shield by which a material to be irradiated is sent into the same hole. (NSA of Japan)

53437 EMERGENCY VALVE FOR A REACTOR. Kishida, Kimihiro (to Mitsubishi Electric Mfg. Co.). Japanese Patent 1968-13835. June 12, 1968. Filed Sept. 21, 1962.

The emergency valve is used for cooling the reactor core when a breakage has occurred in the cooling system. The operation of the valve is "direct" and absolute. The reactor core is immersed in the water pool; it is mounted on the plenum chamber at the reactor bottom. Normally, coolant water is circulated forcibly, from

the reactor bottom, through the plenum room and the core, through the pool water, then into the external circuit. When the external circuit is ruptured, the passage in the plenum-chamber wall is opened, and pool water circulates through the core by convection within the pool. The mechanism of the valve in the passage consists of the following: a cooling water pipe entering the plenum room from the bottom with its nozzle opening within the room in the direction of the passage through the wall; and a valve plate suspended by a hinge which covers the passage hole normally by means of the water pressure from the nozzle, but which opens the passage by returning to the vertical position by gravitation when the coolant flow stops due to a coolant-circuit rupture. (NSA of Japan)

53438 NEARLY COMPLETED NUCLEAR REACTOR FOR DESIGNING NUCLEAR REACTORS. Sutenresu, 11: No. 12, 17-24(Dec. 1967). (In Japanese).

The Japan Materials Testing Reactor (JMTR) of JAERI is described with emphasis on the stainless steels employed for its construction. Some features of the JMTR, built by the Japanese technology, are light-water, enriched uranium type, maximum thermal output 50 MW, 90% ^{235}U enrichment, light-water cooled and moderated, and fast-neutron flux 2×10^{14} n/cm^2 and thermal-neutron flux 3×10^{14} n/cm^2 sec. The JMTR is described in the following: course to construction of the JMTR; purpose of the JMTR; and, places where stainless steels are used and the amounts, including reactor pressure vessel (amount 50 tons), in-pile structure (75 tons), primary coolant system (195 tons), and lining (60 tons). (NSA of Japan)

53439 ROTATING SAMPLES HOLDER. Shimamura, Katsumi (to Mitsubishi Atomic Power Industries, Inc.). Japanese Patent 1968-13715. June 10, 1968. Filed Aug. 7, 1964.

The holder is for irradiating samples in a reactor experimental hole. The advantages are the following: the easy construction; irradiation of samples under the same irradiation conditions; and improved cooling of the samples. It consists of the following: the outer cylinder; a rotating axis within the cylinder; a vane with blades fixed at one end of the axis which rotates the axis on the strength of a flowing liquid; and, sample-holding members fixed onto the axis which revolve when the axis rotates. (NSA of Japan)

53440 SELECTED SAFETY CONSIDERATIONS IN DESIGN OF THE FAST FLUX TEST FACILITY. Simpson, D. E.; Little, W. W.; Peterson, R. E. (Battelle Memorial Inst., Richland, Wash.). pp VI7.1-13 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

A brief description of the FFTF is given. Safety philosophy and criteria for the design of the facility are listed. Transient and accident analyses which have been performed are discussed; the design basis accident is defined. Effects of safety considerations on testing considerations are analyzed. (9 references) (M.L.S.)

53441 SOME PROBLEMS OF SAFE OPERATION OF THE BR-5 PLANT. Orlov, V. V.; Pinkhasik, M. S.; Aristarkhov, N. N.; Efimov, A.; Karpov, A. V.; Nikulin, M. P. (Fiziko-Energeticheskii Institut, Obninsk, SSSR). pp Va7.1-12 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The BR-5 reactor was started up with Na coolant in January 1959. By July 1, 1967, the reactor had operated for 37,700 hours at various power levels, including 5000 kW for 11,200 hours. 98.6×10^6 kWh were produced during this period. Until December 1960, the design operating temperature conditions of the coolant were maintained on the plant: inlet temperature 375°C and outlet temperature 450°C. From December 1, 1960 to date the Na temperature at the reactor outlet has been maintained at about 500°C. In the BR-5 oxide fuel elements, in which the free volume was designed on the basis of a 2% burn-up, the burn-up has reached about 7%. These elements were in operation for about 6 years from the beginning of startup, and a considerable part of this time was spent with punctured elements in the core and with solid and gaseous fuel fission products entering the coolant and the gas cavities of the circuit. Since May 1965 the reactor has been loaded with UC elements which by the middle of 1967 had achieved a burn-up of 2.4%. During operation of the plant, problems associated with the use of Na as coolant have been largely solved. Using cold traps the oxide content has been consistently kept at a level below 3×10^{-3}%, which ensured that there was no detectable corrosion of austenitic steels and that there was no blockage of small orifices in the plant by oxide. Experience gained has shown that sodium is a satisfactory coolant and that building reliable equipment and devices for operation in liquid Na is feasible. During the long operation of the BR-5 reactor there have been a number of scheduled and unscheduled reactor shutdowns, an analysis of which is given. A description of the faults associated with leakage of coolant from plant components and a description of experience in operating the BR-5 reactor with vented fuel elements and a review of some nuclear safety problems with the BR-5 reactor, are given. (auth)

53442 SOME RECENT OPERATING EXPERIENCE WITH EBR-II. Okrent, David (Argonne National Lab., Ill.). pp Va8.1-5 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Operation of the Experimental Breeder Reactor-II is discussed. The detection of Cu in the primary system is described; fuel element failure and its detection are related; changes in power coefficient of reactivity are discussed. Causes of each incident are evaluated. (M.L.S.)

53443 MINIMISING THE HAZARDS ASSOCIATED WITH THE USE OF THE DOUNREAY FAST REACTOR AS AN IRRADIATION FACILITY. Phillips, J. L. (Dounreay Experimental Reactor Establishment, Caithness, Scotland). pp Va4.1-12 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

An operations history of the Dounreay Fast Reactor is given. Use of the reactor as an irradiation facility is discussed. (M.L.S.)

53444 PEC REACTOR COOLANT ACCIDENTS STUDY WITH PARTICULAR REGARD TO A COMPARISON BETWEEN WARD LEONARD AND ELECTRONIC AC-DC CONVERTERS FOR THE COOLING PUMP MOTORS. Melucci, G.; Roselli, G.; Turrini, E. (CNEN, Bologna). pp IVa6.1-23 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Loss of flow accidents in the driver zone cooling circuit of the PEC reactor with particular regard to the power supply failure has been investigated. Useful indication on the choice between two different types of ac-dc converters for the coolant circulating pump motors has been obtained. A preliminary selection of the safety system trip values has been determined. (auth)

53445 AN ANALYSIS OF SOME SAFETY CHARACTERISTICS OF PEC REACTOR AND ITS DYNAMIC BEHAVIOUR IN SOME SELECTED ACCIDENTS. Azzoni, P.; De Cecco, L.; Viotti, V. (CNEN, Bologna). pp IVa7.1-26 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The safety analysis of the PEC Reactor, which is a Na cooled fast reactor for fuel testing, is given. The flow and power transients considered are referred to accidents corresponding to a loss-of-flow in a central loop and to linear reactivity insertions. For this analysis it has been necessary to write a dynamic code. Moreover a code which considers uncontrolled prompt critical accidents has been written. The description of these codes is reported in Appendix. (15 references) (auth)

53446 GENERAL CONSIDERATIONS ON FAST REACTOR SAFETY CRITERIA WITH PARTICULAR REGARD TO PEC REACTOR. Azzoni, P.; Roselli, G.; Zona, R. (CNEN, Bologna). pp IVa8.1-17 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

Procedures used in the safety analysis of the PEC Fast Test Reactor are described. Safety characteristics and classifications are defined; definitions of the credible accident classes are given. Accident and hazards analyses are described. (23 references) (M.L.S.)

53447 MEASUREMENT AND REMOTE-MEASUREMENT TECHNIQUES IN A REACTOR. Schneider, E. Nachrichtentech. Fachber., 31: 22-8(1966). (In German).

From Conference on Telemetry and Remote Control, Kassel, West Germany. See CONF-650680.

A brief description of the MZFR is given. The basis for the performance of a reactor is outlined. The general aspects of the reactor instrumentation are discussed; block diagrams of

the instrumentation are shown. Neutron flux and radiation measurement instrumentation is described; cutaways of the BF_3 and uncompensated ion chambers are shown. Schematics of the neutron flux measuring circuits are given. Instrumentation for the power regulation and safety systems is described. (M.L.S.)

53448 SAFETY CONSIDERATIONS FOR THE KARLSRUHE FAST CRITICAL FACILITY, SNEAK. Bickel, W.; Engelmann, P.; Haefele, W.; Wittek, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp IIa5.1-13 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

SNEAK is a flexible fast zero power reactor. It is the first fast reactor and the first reactor with large amounts of plutonium fuel in Germany. It has been built in the densely populated area of Karlsruhe. Due to these facts the safety aspects of SNEAK had to be emphasized. Engineered and administrative safety precautions are of equal importance and must complement each other in a flexible zero power reactor. The safety features incorporated in the design of SNEAK and the administrative measures to guarantee safe operation of the reactor are described in detail. A short review is given of the operation experience and of the licensing procedure of SNEAK. (auth)

53449 SAFETY PROBLEMS RELATED TO THE ASSEMBLING OF MOCK-UPS IN MASURCA. Brunat, J. G. (CEA, Cadarache, France); Mougniot, J. C.; Storrer, F.; Brion, J.; Stievenart, M.; Van Dievoet, C. pp IIa6.1-16 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

A general description of MASURCA is given; the various fuel rods are described. The model used for accident calculations is given; the safety aspects and procedures of fuel element loading and normal operation are summarized. Core configurations are shown for various fuel element loading phases. (M.L.S.)

53450 FUEL MELTDOWN EXPERIMENTS IN TREAT. Dickerman, Charles E.; Robinson, Lewis E. (Argonne National Lab., Ill.). pp I1.1-15 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

A continuing program of fast reactor safety experiments is underway using the Transient Reactor Test Facility (TREAT) to obtain information on the behavior of fuel and coolant under severe conditions of transient overheating, including gross fuel failure, fuel and coolant motions, and cluster effects such as propagation phenomena. Experimentation has continued on the behavior of metallic EBR-II fuel pins in sodium loops. A sequence of tests on single fuel pins, each surrounded by a ring of six dummy pins, has been completed and analyzed to provide a summary of the results on exposure of these pins singly in a sodium environment. Additional experiments have been performed using small clusters of seven fuel pins in a TREAT integral loop, as a beginning of the study of gross movement and coherence phenomena. Work is currently underway to develop a second generation TREAT integral loop with capabilities for 19-pin clusters of EBR-II type fuel, higher pressure ratings, increased capabilities for remote handling operations, and more nearly complete sodium instrumentation. Recent experiments on irradiated oxide pins have been extended to include the exposure of a 6 a/o burnup sample run in an inert atmosphere with high-speed color photography and fast-response cladding thermocouples. The next phase in this systematic study of oxide behavior is the exposure of similar pins in a sodium environment. (53 references) (auth)

53451 CABRI SODIUM LOOP. Blanc, H. (CEN, Cadarache, France); Lions, N.; Millot, J.-P. pp I2.1-14 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.
See CONF-670916.

The use of a water reactor for the irradiation of fast reactor pins offers many advantages by providing a large flexibility in the experiments as well as a high power density capability despite the precautionary measures set by safety considerations. The basic knowledge of Na boiling and the behavior during the meltdown of a fast reactor fuel pin is very limited; for this reason we considered the construction of a loop located in the center of the CABRI reactor core to study these two problems. This loop can contain one or three pins of the RAPSODIE type. The velocities of Na in the loop will be similar to RAPSODIE. During a loss of cooling accident it will permit the measurement of temperature, flow and pressure histories of the Na as well as cladding and fuel temperatures. In addition, it will provide useful information on the release of fission products into Na. (auth)

53452 SIMPLE EFFECTIVE MODIFICATIONS FOR MINIMIZING COMPENSATION PROBLEMS IN POOL REACTORS. Nucl. Safety, 9: 522-4(Nov.-Dec. 1968).

Two possible solutions to the problem of loss of response in research reactors operated intermittently in the 10 kW to 1 MW region because of low response of the compensated ion chambers are presented. The solution used at Texas A&M University was to attach a voided beam tube to the ion-chamber canister which acts as a collimator by shielding the detector from direct core γ rays. The solution employed at the ORNL Bulk Shielding Reactor was to employ lead shielding with low-sensitivity multisection parallel-circular-plate chambers. (H.D.R.)

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Refer also to abstracts 51154, 51205, 51278, 52160, 52216, 52228, 52241, 52251, 52252, and 53066.

53453 (AEEW-R-602) CORRECTIONS FOR FREQUENCY DOMAIN TRANSFORMATIONS OF WINFRITH BINARY CROSS CORRELATOR RESPONSES. Cummins, J. D. (Atomic Energy Establishment, Winfrith (England)). Apr. 1968. 13p. Dep. CFSTI. UK 2s. 6d.

The corrections for frequency domain transformations of Winfrith binary cross correlator responses are considered: for the finite bandwidth of the equivalent input signal; for the finite time required for the actuator to move between the two positions appropriate to the two levels of the periodic binary chain code input; and for the averaging of experimental determinations of the system frequency response and calculations of the standard deviations of the modulus and phase of the frequency responses determined from the cross correlator responses. (auth)

53454 (BNWL-828) PLUTONIUM UTILIZATION PROGRAM. Technical Activities Quarterly Report, March–May 1968. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. 67p. Dep. CFSTI.

PLUTONIUM RECYCLE TEST REACTOR—fuel element testing in, status of high power density plutonium oxide (PuO_2)–uranium oxide (UO_2); Fuel Element Rupture Test Facility of, irradiation testing of mixed–oxide fuels in; critical tests in, analysis of Batch Core; reactivity variation with burnup of Batch Core fuel in, (T); operations summary for March through May 1968; cooling system of, radioactivity buildup measurements in primary; pressure tubes of, crack propagation characteristics of Zircaloy-2

REACTOR FUEL ELEMENTS—radiation effects on plutonium oxide (PuO_2)–uranium oxide (UO_2), postirradiation examination of; fission gas pressure measurements in irradiated mixed-oxide; reactivity worth measurements on irradiated and unirradiated mixed-oxide; radiation testing in PRTR during March through May 1968

PLUTONIUM RECYCLE CRITICAL FACILITY—control rod worth measurements in, endogenous pulsed source technique for; reactivity temperature coefficients of PRTR Batch Core loading in, (E/T)

REACTOR CONTROL ELEMENTS—reactivity worth measurements on, endogenous pulsed source technique for; reactivity worth of bare and cadmium-covered poison rods in PRTR Batch Core

CRITICALITY STUDIES—measurements of critical number of aluminum–plutonium fuel rods in water moderator, effect of lattice pitch and boron concentration on; microscopic lattice parameter measurements on water-moderated plutonium oxide (PuO_2)–uranium oxide (UO_2) rods; measurements of boron worth and concentration for cold and xenon-free PRTR Batch Core

NEUTRONS—capture-to-fission ratio measurements in plutonium-239; multiplication factor determination in water-moderated plutonium oxide (PuO_2)–uranium oxide (UO_2) lattices; resonance escape probability determination for uranium-238

TUBES—crack propagation characteristics of zirconium–niobium alloy, under pressure cycling; crack propagation characteristics of irradiated and unirradiated Zircaloy-2, under pressure cycling

PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, radiation effects on vibrationally compacted fuels of

AMERICIUM OXIDES—gamma dose rate measurements on

GAMMA RADIATION—dose rate from americium oxide (AmO_2) source
FISSION PRODUCTS—release rate measurements in irradiated mixed-oxide fuel rods
PLUTONIUM-239—neutron capture-to-fission ratio in
REACTOR FUELS—conversion ratio determination for water-moderated mixed-oxide
URANIUM-238—neutron resonance escape probability for
NIOBIUM ALLOYS—Nb–Zr, crack propagation characteristics of hydrided and unhydrided pressure tubes of
ZIRCALOY-2—crack propagation characteristics of irradiated and unirradiated pressure tubes of (H.D.R.)

53455 (BNWL-850) PROTEUS: A COMPUTER CODE TO EXTEND THE BURNUP DATA FROM A POINT BURNUP CODE. Eschbach, E. A.; Deonigi, D. E.; Kanninen, M. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1968. Contract AT(45-1)-1830. 88p. Dep. CFSTI.

A computer code named PROTEUS has been developed to modify and extend data produced by the reactor fuel burnup code ALTHAEA in its zero dimensional mode. PROTEUS simulates either batch or graded fueling, prepares a table of maximum-to-minimum ratios of fuel specific power at constant flux, and calculates analytical curve fits of isotopic concentrations versus burnup. (auth)

53456 (BNWL-861) STATUS OF THORIUM FUEL TECHNOLOGY. Leggett, R. D.; Kemper, R. S. (eds.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 180p. Dep. CFSTI.

Available information on the irradiation behavior of Th and Th alloys is analyzed. The physical and mechanical properties of Th are presented. The physical and mechanical properties are also listed for ThC, ThO_2, TnN, Pu–Th, Th–U, and Th–Zr. The corrosion properties of Th and Th alloys in water are presented. Fabrication processes for reactor grade Th are described. Fuel element fabrication of Th is described. Radiation effects on Th. and Th–U are analyzed. Dimensional stability and mechanical properties are examined. Performance of an irradiated Th–U–Zr fuel element is described. (D.C.C.)

53457 (BMwF-FBK-68-17) CONSTRUCTION OF AN EXACT SOLUTION OF THE BOLTZMANN EQUATION IN MEDIA WITH CYLINDRICAL GEOMETRY BY SUPERPOSING FUNDAMENTAL MODES (CASE SOLUTIONS IN PLANE GEOMETRY). Nonnenmacher, T. (Technische Hochschule, Karlsruhe (West Germany). Institut fuer Struktur der Materie). June 1, 1967. 35p. (In German). Dep.

A solution of the stationary Boltzmann equation for monoenergetic neutron transport in homogeneous media with cylindrical geometry and isotropic scattering is constructed by superposing fundamental solutions (Case-solutions). The result is an expansion of the angular flux in a series of Tchebichef polynomials of the first and second kind. These series can be summed up and one finds an exact solution regular at the origin. 11 references. (auth)

53458 (EUR-4049) COMET CODE: COMPUTATION OF THE MECHANICAL AND THERMAL STRESSES IN FUEL ELEMENT CANS. Fantozzi, M. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 13, 1968. 30p. (In Italian). Dep.

By the COMET code, a method has been established to calculate mechanical and thermal stresses in a cross section of fuel element claddings in a vertical pressure tube reactor, taking into account circumferential and radial temperature distributions. Axial stresses are evaluated by different schemes, according to the fuel element structure and the coolant circulation direction. (auth)

53459 (GEMP-619) INTERIM SUMMARY OF WORK APPLICABLE TO ECC ON PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 UNDER REACTOR ACCIDENT CONDITIONS. White, J. F. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). June 1968. Contract AT(40-1)-2847. 41p. Dep. CFSTI.

Physico-chemical studies of clad UO_2 under reactor accident conditions are described, and studies on the behavior of Zircaloy- and 304 L SS-clad UO_2 fuel elements in steam and steam plus air above 1000°C are discussed. These studies are directed to the behavior of these fuel elements and associated reactor core materials under a loss-of-coolant core meltdown incident. Experimental work emphasized studies on the kinetics of oxidation of UO_2 to 1830°C; studies of the steam and air oxidation kinetics of Zircaloy-4 to 1800°C; studies of the steam and air oxidation kinetics of 304 L SS to 1375°C; studies to determine the effect of internal pressure on the behavior of Zircaloy-4 cladding as a function of heating rate; tests to determine the effect of oxidation on the deformation and failure of pressurized Zircaloy-4 tubing; measurements of spectral and total hemispherical emittance of unoxidized and oxygen saturated Zircaloy-4 and of oxide films on Zircaloy-4; construction of a test assembly for pressure testing of irradiated Zircaloy tubing at various heating rates in the 10 to 90°C/sec range, and completed preparation of $UO_{2.003\pm0.003}$ samples of 98% theoretical density for thermal conductivity measurements at various laboratories. (auth)

53460 (JUL-529-RX) NONDESTRUCTIVE DETERMINATION OF THE NUCLEAR FUEL CONTENT OR THE BURNUP IN FUEL SAMPLES OR REACTOR FUEL ELEMENTS. Dieck, E. Leopold (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente). June 1968. 95p. (In German). Dep.

Thesis. Submitted to Technische Hochschule, Aachen, Ger.

A study was made to find a method for burnup determination by γ spectroscopy. Studies with NaI(Tl) crystal spectrometers were carried out and the results showed burnup measurement by secondary irradiation was possible. By difference formation, all long-lived fission products in the γ spectrum were eliminated. This method is less suitable for burnup determination than routine methods, but for laboratories without Ge(Li) semiconductor detectors it offers a relatively fast method for burnup determination if a computer program for spectral evaluation is available. Further studies led to the integral measurements and to a comparison method similar to activation analysis for unknown fission product mixtures. An automatic measurement installation was constructed, which simultaneously accepts the control of a fast pneumatic tube for the irradiation of the U-containing sample. Burnup measurements were made on coated particles with this installation. (tr-auth)

53461 (LA-3547) EFFECTS OF REACTIVITY EXCURSIONS ON COATED FUEL PARTICLES. Adler, Felix T. (Los Alamos Scientific Lab., N. Mex.). Jan. 1968. Contract W-7405-eng-36. 52p. Dep. CFSTI.

The breakup mechanism of pyrolytic carbon (PyC) coated fuel particles imbedded in a graphite matrix is investigated with the aim of establishing threshold values for energy deposition rates necessary to reach cracking of the coating and for the onset of matrix damage. The experimentally observed difference in response between particles containing a uranium carbide core and those containing a uranium oxide core can be understood as the consequence of the formation of CO or CO_2 in the oxide particles during the reactivity excursion. The resulting gas pressures lead to cracking of the shell and breakup of the matrix. Carbide particles develop a sizeable vapor pressure of C or U only at temperatures well above the melting point of uranium carbide. Simple thermomechanical considerations are presented, showing that two different heat transfer mechanisms control the response of the carbide particles to a reactivity pulse. Simple models are presented for the energy balance during the pulse, which led to threshold values for the energy deposition rate necessary for onset of cracking and of matrix damage. Expressions for the expected pauses between onset of cracking and of matrix damage are obtained using simple models for the anisotropic heat transfer in the shell. In determining the thermal stresses, the effect of the matrix has also been considered so that the results depend explicitly on the fuel loading of the whole fuel body. (auth)

53462 (TID-24744) PROPOSED GUIDE FOR PREPARATION OF FUNDAMENTAL MATERIAL CONTROLS AND NUCLEAR MATERIALS SAFEGUARDS PROCEDURES. Revision A. (Division of Nuclear Materials Safeguards (AEC), Washington, D. C.). Apr. 1968. 22p. Dep. CFSTI.

A guide describing the practices suitable for the detection of diversions of special nuclear material is presented. The guide includes: identification of basic principles of materials safeguards; a description of the type of information pertinent to the form of fundamental material controls; and definitions for information to be submitted as formal procedures. (D.C.C.)

53463 (UNC-5217) FAST REACTOR MIXED-CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM. Third Quarterly Progress Report, January–March 1968. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). July 10, 1968. Contract AT(30-1)-3415. 51p. Dep. CFSTI.

The status of the UC–PuC pellet rod irradiations in EBR-II is summarized. Mixed-carbide annular pellet irradiation capsule assemblies are described, and the specimens prepared for fission gas release testing are tabulated. Sodium-bonded carbide fuel irradiation capsule design is shown. High-density UC, UC–PuC, and UO_2–PuO_2 specimens were fabricated, and the kinetic and thermodynamic compatibility of mixed-carbide fuel with stainless steel-cladding was evaluated. (H.D.R.)

53464 (WAPD-TM-801) COLLIDED FLUX DIFFUSION THEORY. Harris, D. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Aug. 1968. Contract AT-11-1-GEN-14. 33p. Dep. CFSTI.

A collided flux diffusion theory is developed and tested by comparison with exact solutions and with conventional diffusion theory solutions. Further improvement is achieved by use of a selected three point (in one dimension) approximation for the scattering integral. Special problems such as diffusion in holes and inclusion of anisotropic scattering are treated. (auth)

53465 EXPERIMENT ON THE HIGH-STRESS FATIGUE AT A NOZZLE ON THE REACTOR PRESSURE-VESSEL. Kameoka, Toshio; Sato, Eiichi (Kobe Steel Ltd., Japan). Koatsuryoku, 5: 1093-1101(Sept. 1967). (In Japanese).

Fatigue strengths for high stress and low cycle conditions at a nozzle on the reactor pressure vessel where stress concentration occurs are determined. Two kinds of both the through and flush-type nozzles for reactor pressure-vessels are used in the experiment with four vessels for each kind. The repeated internal pressures applied are about 3 to 5 times larger than the design value. The number of repetitions for the occurrence of a breakage is in the range of 3×10^3 to 2.5×10^4. For a series of experimental vessels, the strain behavior at the nozzle corner on the inner side of the vessel due to repeated internal pressures could successfully be measured till a breakage occurred. (NSA of Japan)

53466 TEMPERATURE CALCULATION IN NUCLEAR FUEL ELEMENTS WITH DEFECTS BY ELECTRICAL ANALOG METHOD. Minashin, V. E.; Gribanov, Yu. I.; Sholokhov, A. A.; Zasorin, I. P.; Gromov, V. G. At. Energ. (USSR), 25: 187-92 (Sept. 1968). (In Russian).

An accurate method is presented for calculating temperature distribution in fuel elements with defects of various kinds such as fuel cracks, nonconductive void ingredients, cladding exfolations, etc. The method is based on the solution of partial differential equations governing the heat transfer process. The method permits three dimensional temperature distributions in fuel rods having spatial irregularities to be determined. It is shown that the fuel rod local temperature jump is far larger if the fuel-cladding contact failure strip extends infinitely in the longitudinal direction compared with the case when the fuel-cladding contact failure occurs only in a small region limited in tangential as well as in longitudinal direction. The method based on the use of local heat transfer coefficients has been criticized as it does not take into account many factors inherent in the heat transfer phenomena in question. (auth)

53467 INTERNATIONAL CONFERENCE ON THE PHYSICAL PROBLEMS OF REACTOR SHIELDING. Carbo, A. Energ. Nucl. (Madrid), 12: 157-72(Mar.-Apr. 1968). (In Spanish).

The results of a conference on reactor shielding are summarized. Topics discussed include: solutions to one dimensional neutron transport problems, solutions to one dimensional gamma transport problems, radiation shielding studies, radiation attenuation in tubes and cavities, geometrically complex shields, and comparison of calculation and measurements in power reactors. (52 references) (M.L.S.)

53468 OPTIMIZATION OF NEUTRON FLUX DISTRIBUTION. Suda, Nobuhide; Yamaguchi, Tetsuo; Sakurai, Yoshifumi (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo), 5: 452-7(Sept. 1968).

A method of optimizing neutron flux distribution to obtain maximum power generation from a given core is presented. Constraining conditions governing maximum heat flux and control rod absorption are taken into consideration. The problem is reduced to that of optimal control. In the case of one group model the phase plane technique is effective for an intuitive analysis of the problem. It is verified that the solution satisfies Pontryagin's principle. The solution is one of "band-pang type." The result is extended to the case of two group models, assuming that the solution will again be of bang-pang type. A comparison is made between the one group and the two group models. (auth)

53469 SOME ASPECTS OF STATISTICAL METHOD APPLICATION TO OPERATIVE RESEARCH PROBLEMS FOR REACTOR KINETICS. Seliverstov, B. N.; Efanov, A. I.; Bykov, Yu. M.; Gavrilov, P. A.; Konstantinov, L. V. At. Energ. (USSR), 25: 287-92(Apr. 1968). (In Russian).

The dynamic characteristics of a nuclear reactor are determined by continuous processing of statistical data from a detector to a digital computer. Special attention is paid to methods of data processing. Emphasis is placed on determination of actual measuring time required, autocorrelation function power spectrum measurements, and the determination of optimum filter flattening under cutoff conditions of the correlation function. The possibility of using the statistical method to determine dynamic anomalies of a reactor plant is presented. (auth)

53470 EXPERIMENTAL CALIBRATION OF MATCHING FOILS FOR AVOIDING THERMAL NEUTRON FLUX PERTURBATION. Obu, Makoto; Ichimori, Toshihiro (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 5: 447-51(Sept. 1968).

An experimental calibration of flux perturbation has been made with specially prepared neutron detecting foils producing only negligible perturbation in the thermal flux in a graphite medium. The foil material was composed of a 99.8% D_2O solution of $MnSO_4$. The Mn in the $MnSO_4$ served as the activating substance. The detecting foils were so prepared as to possess a moderating ratio equal to that of the medium. The calibration was made near the matching point, with foils of various concentrations of Mn, ranging from 1.39 to 13.9 Mn-mg/cc. The results of experiment indicated that the perturbation near the matching point was fairly insensitive to Mn concentration. The matching concentration was determined graphically. (auth)

53471 GERMAN DEVELOPMENT OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Mackenthun, Werner (VDEW-Geschaeftsstelle, Frankfurt am Main). At. Strom, 14: No. 6, 80-4(June 1968). (In German).

A summary of the development of prestressed concrete reactor vessels is given. Containment design parameters are tabulated for various reactors in France, Great Britain, and the USA; reactor operating parameters are listed. Cutaway diagrams are shown for the EDF-4 containment, a 600 MW AGR-type containment, and two types of containment structures developed in Germany. (M.L.S.)

53472 DRIVING DEVICE FOR A PILE OSCILLATOR. Hisatsune, Hideyoshi (to Meidensha Electric Mfg. Co., Ltd.). Japanese Patent 1967-24621. Nov. 27, 1967. Filed Apr. 26, 1965.

The driving device proposed is for a pile oscillator, which measures the reactor transfer function by a plurality of samples with reactivities in the reactor core. The advantages to the device are the improved reproducibility and accuracy of the sample movement period and the halting point. The device consists of the following: a long, square tubular body partitioned axially in a plurality of sections with a magnet at the outside end; a plurality of the long, square, "upper-side open" tubular bodies each running through each section with a sample at the reactor core end; the racks each attached onto the inside of each tubular body which engage with the driving gears; the drive mechanism which thus moves the tubular bodies with samples in the each-other reversed directions; buffers for the movement; and, multiple limit switches, actuated by the tubular bodies which control the operation of the drive mechanism. (NSA of Japan)

53473 IMPROVEMENTS IN OR RELATING TO SUPERVISORY CIRCUIT ARRANGEMENTS. Wood, Peter; Hunter, David; Whyard, Robert Edward; Keats, Albert Brian (to United Kingdom Atomic Energy Authority). British Patent 1,129,161. Oct. 2, 1968. Filed May 28, 1965.

A reactor control system for monitoring a group of separate conductors to establish whether a number of these conductors are in a correct condition is described. The system consists of a pulse generator, controlled input circuits, and gated elements for analyzing the condition of the apparatus. (W.H.K.)

53474 REACTOR FUEL ROD. Azuma, Masao (to Hitachi Ltd.). Japanese Patent 1968-10712. May 9, 1968. Filed Mar. 26, 1965.

The reactor fuel rod, consisting of the cladding tube, ceramic fuel pellets with an axial hole piled one upon another, and a support running axially through the series of holes, has the advantages: prevention of the collection of crumbled fuel chips which results in the fuel melting; and, prevention of the cladding tube rupture. As the support, a sort of spring made of a heat-resistant material in the form of a spiral is used. The spring runs through the series of axial holes and is in contact with the surface of holes. (NSA of Japan)

53475 HEAT INSULATOR FOR THE REACTOR PRESSURE-VESSEL. Matsuda, Naoe (to Hitachi Ltd.). Japanese Patent 1968-10714. May 9, 1968. Filed Nov. 9, 1965.

The heat insulator is composed of the insulator panels surrounding a reactor pressure vessel; each panel is made up by constructing insulator blocks in such a way that vertical seams of the adjoining blocks in layers are not vertically aligned. For the cylindrical part of pressure vessel, the corresponding heat insulator is divided in three panels for the areas of core, upper and lower nozzles; each panel is installed onto the vessel by suspension. (NSA of Japan)

53476 DEVICE FOR INSERTING AN EMERGENCY CONTROL ROD INTO A NUCLEAR REACTOR. (to Societe Anonyme Societe

d'Etude de la Propulsion par Reaction). British Patent 1,129,565. Oct. 9, 1968. Priority date May 12, 1965, France.

A nuclear reactor shutdown control rod drive assembly is described. The control rod system consists of a telescopic cylindrical device which can be extended in a cylindrical guide duct to the reactor. The telescopic cylindrical device is actuated by a contained explosive charge which extends the sections. A braking system is provided by the cylindrical support and outer sleeve. (D.C.C.)

53477 AXIAL DIFFUSION COEFFICIENT IN A LATTICE: A DIRECT DERIVATION OF BENOIST'S FORMULA. Bonalumi, R. (CISE, Milan). Energ. Nucl. (Milan), 15: 608-9(Sept. 1968).

Benoist's formula for the axial diffusion coefficient in a uniform cylindrical core is derived in terms of first collision probabilities. (M.L.S.)

53478 NUCLEAR REACTOR PRESSURE VESSEL. (to Societe Indatom SARL). British Patent 1,129,573. Oct. 9, 1968. Priority date Apr. 27, 1966, France.

A description of a prestressed concrete pressure vessel for a nuclear reactor is presented. The pressure vessel has a lining membrane of low-carbon nickel steel. The lining membrane is separated from the concrete by heat-insulating layer with coolant tubes. (D.C.C.)

53479 IMPROVEMENTS IN OR RELATING TO FUEL FOR NUCLEAR REACTORS. (to Gulf General Atomic Inc.). British Patent 1,130,015. Oct. 9, 1968. Priority date Apr. 19, 1965, United States.

A nuclear reactor fuel element is described which consists of an elongated tubular structure with a flexible can. A portion of the fuel element contains no fuel and has a dumb-bell cross-sectional shape. The unoccupied space between the fuel and the flexible can contains a liquid metal heat transfer medium. The fuel compact contains an axial hole running the entire elongated length. The fuel elements are arranged in a square-lattice cluster. (D.C.C.)

53480 ASSESSMENT OF SENSING CHANNELS FOR HIGH INTEGRITY PROTECTIVE SYSTEMS. Green, A. E. (United Kingdom Atomic Energy Authority, London). Instrum. Pract., 22: 862-9(Oct. 1968).

Sensing channels for high integrity protective systems require to have their performance substantiated far beyond that of any normal application. An approach to this problem is to carry out an independent safety assessment. Some aspects of the assessment method applied to sensing channels of automatic protective systems for nuclear reactors and other plants are discussed. Of all the performance characteristics which require to be assessed, reliability is salient. Some facets of reliability prediction are described. (auth)

53481 HEAT TRANSFER IN ROD BUNDLES FOR LONGITUDINAL FLOW OF LIQUID METAL COOLANT. Sholohov, A. A.; Minashin, V. E. At. Energ. (USSR), 25: 280-6(1968). (In Russian).

Heat transfer is analyzed in triangular or square array fuel rods for axial turbulent flow of liquid metal. The turbulent flow of liquid metal coolant is treated as slug flow approximation which leads to good results for moderate Reynolds number range. An analog device is used in solving the heat transfer equations. The local temperature distribution and average surface-to-liquid temperature differences are dependent on rod spacing and rod thermal conductivity. The effect of these two factors is investigated. The presented results may be of practical importance for calculating surface temperature distribution in a nuclear reactor core consisting of fuel rods cooled by liquid metal. The method of calculating the surface temperature distribution in fuel elements by heat transfer factor is criticized. (auth)

53482 REACTOR FUEL ROD. Ishikawa, Kivoshi (to Hitachi Ltd.). Japanese Patent 1968-14640. June 20, 1968. Filed Jan. 23, 1965.

The fuel rod proposed is of the sintered-pellets type. Advantages are reduction of rod damage, high power-density operation, and improvement of the reactor economy. In the fuel rod, in order to balance the axial thermal expansion of the cladding tube and that of the series of non-metallic sintered fuel pellets, metal rings are inserted between the respective pellets within the cladding. (NSA of Japan)

53483 NUCLEAR REACTOR FUEL ELEMENT. (to United States Atomic Energy Commission). British Patent 1,129,530. Oct. 9, 1968. Priority date Mar. 7, 1966, United States.

Described is a superheater fuel element comprising a number of tubes extending between two tube sheets with fuel material surrounding the tubes and a tubular jacket enclosing both fuel and tubes. The steam first passes through the outer tubes and is deflected to flow through the inner tubes. The element is prestressed to reduce the stresses resulting from differences in the thermal expansion of the cooler outer tubes and the hotter inner tubes. This arrangement allows the fatigue life of the element to be extended. (H.D.R.)

53484 MECHANISM OF DRIVING A CONTROL ROD. Oguchi, Isao (to Hitachi Ltd.). Japanese Patent 1968-10689. May 6, 1968. Filed Nov. 27, 1964.

By the method proposed, the reactor scram can be done rapidly and absolutely. It consists of the following: a control rod, a pipe, a rod and an iron core connected to the bottom of a control rod in the order; a guiding pipe extending downward from the reactor bottom; an electromagnet located around the guiding pipe for attracting the iron core that is connected to a differential transformer located below around the guiding pipe; and, a spring directly below the iron core against the force of which the iron core is held by the electromagnet. The part of the guiding pipe where electromagnet and iron core are situated is made up by arranging sections of a magnetic material and of a non-magnetic material alternately circumferentially. In scramming the reactor, the excitation to the electromagnet is cut off. (NSA of Japan)

53485 SURVEY OF F.R.G.: NUCLEAR INSTRUMENTS. Schallopp, B. Nucl. Eng., 13: 772-3(Sept. 1968).

A review is given of current and future practices in nuclear instrumentation and reactor control in German installations, including a discussion of in-pile and out-of-pile neutron detectors and applications of computers. (UK)

53486 REACTIMETER: ITS UTILIZATION. Chauvet, G. (CEN, Grenoble, France); Tournier, E.; Villain, P. pp Va6.1-5 of Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19–22, 1967. Denielou, G. (ed.). Paris, Commissariat a l'Energie Atomique, 1967.

See CONF-670916.

The basic principles of the reactimeter are given. The kinetics equations solved by the reactimeter are discussed. Basic components are listed; function and operation are outlined. (M.L.S.)

53487 RELIABILITY OF REACTOR COMPONENTS. Rubel, P. Nucl. Safety, 9: 481-6(Nov.-Dec. 1968).

Probabilistic modeling techniques are currently attracting attention in regard to reliability evaluation of vital systems in reactor plants. Programs are in effect or being considered to develop arrays of component reliability factors for use in system models that are based entirely on failure statistical data. However, there are significant practical reasons why such data may lead to erroneous or irrelevant conclusions regarding performance of critical components in unusual applications; moreover, many system failures cannot be attributed directly to any actual component failure of the types represented statistically. It appears that these modeling limitations can be largely overcome by comprehensive analyses of selected critical components and interpretation by equipment specialists of all available information relevant to component applications. Some simplification of the system models is also desirable and can be accomplished by treating rather extensive subsystems as components. 7 references. (auth)

53488 WIDE-RANGE NUCLEAR CHANNELS. Roux, D. P. Nucl. Safety, 9: 486-93(Nov.-Dec. 1968).

A single channel of instruments covering the entire range of reactor power from source level to full power is highly desirable. This range covers 8 to 10 decades of reactor power. Three concepts that have been used or proposed are the wide-range analog counting channel, the wide-range digital counting channel, and the combination counting–Campbelling channel. These three systems are described briefly and compared on the basis of nuclear detection characteristics, reliability, experience, complexity, and cost. 19 references. (auth)

GENERAL

53489 (AE-327) PHYTOPLANKTON FROM TVAEREN, A BAY OF THE BALTIC, 1961–1963. Willen, Torbjoern (Aktiebolaget Atomenergi, Stockholm (Sweden)). Sept. 1968. 75p. Dep.

The investigation of the qualitative and quantitative composition of the phytoplankton in Tvaeren, a bay of the Baltic, was carried out during the period April 1961 to October 1963. Comprehensive data exist concerning physical and chemical conditions; some of them are included in this paper. A low number of species occur in brackish water; most of them belong to the groups Diatomeae and Peridineae. The total volumes of phytoplankton are low and show peaks only in spring, with some genera, Sceletonema, Thalassiosira and Gonyaulax, predominating. The vertical and seasonal distribution of different groups is discussed. With the exception of the periods of circulation the total volumes showed a marked decrease from about 25 m and deeper. At 50-70 m the occurrence of some Peridineae often caused a marked increase in total volumes. A comparison with corresponding values from another locality, situated at Bergoe, did not show any great difference. (INIS) (SWEDEN)

53490 (AECL-3116) ORGANIC COOLANT TOXICITY TO FISH. Guthrie, J. E.; Acres, O. E. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). May 1968. 14p. Dep. CFSTI. CAN $0.50.

The use of terphenyl compounds as a coolant for nuclear reactors raises questions about the effect of these substances in the aquatic environment, should they be accidentally released. Santowax OM and HB-40 are two terphenyl-type coolants under study at Whiteshell Nuclear Research Establishment; HB-40 may be the coolant of choice. The toxicity of these coolants to rainbow trout fry has been examined. The lethal threshold concentration of Santowax OM + 30% high boilers is between 5 and 10 mg/l, when the dissolved oxygen concentration ≥8 mg/l. Minimum dissolved oxygen conditions (4 to 5 mg/l) reduced significantly the time required to kill 50% of the test fish. The lethal threshold concentration of HB-40 to trout fry appears to be greater than 100 mg/l. The behavior of the fish when exposed to these coolants is briefly described. (INIS) (Canada)

53491 (ANL-7344) ROOT-CUBING AND THE GENERAL ROOT-POWERING METHODS FOR FINDING THE ZEROS OF POLYNOMIALS. Bareiss, Erwin H. (Argonne National Lab., Ill.). June 1967. Contract W-31-109-eng-38. 88p. Dep. CFSTI.

The root-squaring and root-cubing method is generalized and called the general root-powering method. A simple representation, suitable for coding, is obtained by introducing partitioned polynomials. The method is extended to include analytic functions. (auth)

53492 (ANL-7440) NUMERICAL INVERSION OF FINITE TOEPLITZ MATRICES AND VECTOR TOEPLITZ MATRICES. Bareiss, Erwin H. (Argonne National Lab., Ill.). June 1968. Contract W-31-109-eng-38. 16p. Dep. CFSTI.

A method is introduced by which the exact numerical inversion of finite Toeplitz matrices can be accomplished simply, using in the order of n^2 multiplications. Some efficient algorithms are given. Extension is made to vector Toeplitz matrices which occurred in the author's work. (B.G.D.)

53493 (BNL-12532) ROLE OF CHLORIDE ION IN PHOTOSYNTHESIS. Hind, G.; Heath, R. L.; Izawa, S. (Brookhaven National Lab., Upton, N. Y.). [1968]. 12p. (CONF-680612-1). Dep. CFSTI.

From International Congress for Photosynthesis Research, Freudenstadt, Germany.

The response of illuminated chloride-ion-depleted chloroplasts to the addition of chloride ions at various intervals after the onset of illumination. The control curve had a slope of almost zero following an initial burst of electron flow. As the illumination interval without the chloride ion was prolonged, restoration to the control rate was decreasingly successful. Results of additional experiments demonstrated that chloroplasts were irreversibly photoinactivated by illumination in the absence of the chloride ion. With ferricyanide or NADP as the terminal electron acceptor, only the uncoupled and coupled electron flow components required the chloride ion. The excess fluorescence yield induced by actinic light was determined as a function of actinic light intensity and of fluorescence yield intensity. It appears that the chloride ion requirement is related to the hydrogen ion uptake reaction. However, many peptidases are activated by anions in the same concentration range with the same specificity as the chloride ion effect, and chloride ion flux studies are being undertaken in order to distinguish between these two possible mechanisms. (H.L.W.)

53494 (BNL-50119) CHEMICAL TITLES: A COMPUTER INFORMATION RETRIEVAL DATA SYSTEM. Baldwin, Roger (Brookhaven National Lab., Upton, N. Y.). May 1968. 49p. Dep. CFSTI.

The Chemical Titles Data System, a set of seven computer programs, is described. This data system processes a magnetic tape received fortnightly from the Chemical Abstracts Service containing many significant publications in chemistry and related fields. The data system receives input from Brookhaven National Laboratory scientists describing their professional interests and selects publications from the magnetic tape corresponding to these interests. (auth)

53495 (COO-235-49) PROGRESS REPORT [ON GENETICS], MAY 1967–MAY 1968. (Indiana Univ., Bloomington. Dept. of Zoology). May 1968. Contract AT(11-1)-235. 47p. Dep. CFSTI.

Investigations designed to elucidate the nature, origin, and relations of the cytoplasmic symbionts of Paramecium aurelia are described and results are discussed. Areas under study were DNA, physiological maintenance of cultures, cell nuclei communication functions, kinetosome development, genetic and gene control mechanisms, and detection of mutations. (B.S.L.)

53496 (K-1749) FRACTIONATION OF SUSPENDED AND COLLOIDAL PARTICLES IN NATURAL WATER. Lammers, William T. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 10, 1968. Contract W-7405-eng-26. 42p. Dep. CFSTI.

Feasibility studies were conducted in the Biophysical Limnology Laboratory on the use of centrifugal techniques for isolating insoluble materials from samples of natural water. The isolated particulate fractions were then used in studies encompassing several areas of water pollution with particular emphasis on the characterization of different groups of isolated particles. These characterizations were confined to the physical, chemical, and biological properties of suspended and colloidal particles which influence their separation, concentration, and analysis. Systems and techniques were developed for separating these materials into relatively pure particulate groups and for making reliable analytical determinations. A discussion of particle characterization methods and the instruments, techniques, and calculations used in isolating the different particulate groups for study are presented. (auth)

53497 (K-1750) GAS HEAT EXCHANGER PROGRAM (GHEP). DeLozier, Randall C. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Oct. 11, 1968. Contract W-7405-eng-26. 133p. Dep. CFSTI.

A FORTRAN coded gas heat exchange program (GHEP) that was developed as a design aid in minimizing the costs of energy removal in a gas cooling process is described. Water was used as a coolant, and air was selected as the gas heat transfer media in these studies; however, the program is general to facilitate the use of other gases and coolants. Provisions of the program include the ability to study the effect of gas cooler parameters on the total cost of the system. The total cost is based on gas heat losses, coolant heat losses, pumping cost, and the amortized sum of the capital costs of the energy removal system. Instructions for using GHEP and a sample problem (designing an air cooler with energy recovery) with input and output sheets are included. (auth)

53498 (LA-3848, pp 11-20) CELLULAR RADIOBIOLOGY SECTION. (Los Alamos Scientific Lab., N. Mex.).

Thirty-two abstracts of papers and manuscripts define briefly the scope of the research activity in this section. In general, the abstracts reflect the following areas of investigation: competence-stimulating activities in Hemophilus influenzae; polyriboadenylate synthesis by nuclei of sea urchin embryos; sialic acid regeneration in Chinese hamster cells; RNA synthesis and stability in relation to cell division in mammalian cells and Stentor coeruleus; genetics and kinetics of dehydrogenases; cell volume analyses; life cycle analyses in mammalian cells; biochemical activity in synchronized cell cultures; and properties of mitotic cells obtained by shaking. (E.R.B.)

53499 (LA-3979) SIMULATION OF TWO ARITHMETIC STRUCTURES. Blandford, R. C.; Metropolis, N. (Los Alamos Scientific Lab., N. Mex.). Mar. 1968. Contract W-7405-eng-36. 9p. Dep. CFSTI.

Two classes of arithmetic are incorporated, by programming,

into a computer. The first, significant-digit arithmetic, provides for the monitoring of precision in a computation. The second, specified-point arithmetic, is a generalization of the conventional fixed-point type. The implementation is discussed. As an application of the first type, a new technique is described for function evaluation based on polynomial approximation. (auth)

53500 (NP-17633) FOURTEENTH ANNUAL REPORT, 1965-66. (Australian Atomic Energy Commission). 104p. Dep.

The organization and research programs of the Australian Atomic Energy Commission for 1965-1966 are discussed. Topics include nuclear power, peaceful uses of nuclear explosives, desalination, raw materials, research programs in reactors, radiochemistry and radioisotope applications, production and uses of radioisotopes, research establishment operations and safety, administration, and other general aspects. (B.G.D.)

53501 (NYO-3759-5) ANNUAL PROGRESS REPORT [ON PHOTOSYNTHETIC ENERGY CONVERSION], SEPTEMBER 1, 1967-AUGUST 31, 1968. Clayton, Roderick K. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-3759. 10p. Dep. CFSTI.

The photosynthetic bacterium, Rhodopseudomonas spheroides, was used for studies on isolation and characterization of photochemical reaction centers. Light-induced absorption difference spectra of reaction centers showed reversible effects. Architecture of reaction centers was determined from the polarization of P870 fluorescence. Fluorescence of reaction centers was studied in relation to their photochemical activity. The high concentration of photoreactive material in the reaction centers allows measurement of the photosynthetic electron spin resonance signal with unusually high signal to noise ratio and affords an accurate correlation with the photochemical events inferred from optical absorbance measurements. Kinetics and thermodynamics of excitation transfer among light harvesting pigments of photosynthetic bacteria were studied. Delayed fluorescence and chemiluminescence in photosynthetic tissues of spinach chloroplasts were studied. (H.L.W.)

53502 (ORNL-tr-1990) APPLICATION OF NUCLEAR PHYSICS IN RELATED SCIENTIFIC FIELDS AND THE NATIONAL ECONOMY. Leipunskii, A. I. Translated for Oak Ridge National Lab., Tenn., from Usp. Fiz. Nauk, 95: 15-23(May 1968). 17p. Dep. CFSTI.

The development of nuclear physics and atomic energy for peaceful purposes in the Soviet Union is described. Application of the science to related fields is described and forecasts are made for the future. The possibilities of using atomic energy for space travel, large scale electrical power, and transportation are discussed. (J.W.R.)

53503 (ORNL-tr-1995) AUTOMATIC RETRIEVAL OF NUCLEAR ENGINEERING INFORMATION: RESPONSA PROJECT. Holm, Hans I. Translated for Oak Ridge National Lab., Tenn., from Tidskr. Dok. (Swed.), 24: No. 3, 38-43(1968). 9p. Dep. CFSTI.

An experiment was conducted to test the computer program RESPONSA, to determine whether the indexing methods for Nuclear Science Abstracts give a meaningful result with machine searching. A brief analysis is given. (J.C.W.)

53504 (UCRL-18293) APPLICATION OF ELECTRON DIFFRACTION TO PROBLEMS IN BIOLOGICAL ELECTRON MICROSCOPY. Glaeser, R. M.; Thomas, G.; Christensen, R.; Brammer, W. G. (California Univ., Berkeley. Lawrence Radiation Lab.). June 12, 1968. Contract W-7405-eng-48. 5p. (CONF-680905-1). Dep. CFSTI.

For presentation at 26th Annual Meeting of the Electron Microscopy Society of America, New Orleans, La.

The application of selected area diffraction, dark field imaging, and low-angle Fourier contrast to biological materials is discussed. (B.G.D.)

53505 (Y-1627) COMPUTER PROGRAMS FOR CALCULATING PEAK TEMPERATURE DISTRIBUTION IN WELDING. Huber, R. A.; Bradway, D.; Wiedemann, C. M.; Turner, P. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 16, 1968. Contract W-7405-eng-26. 47p. Dep. CFSTI.

Computer programs have been developed for solving cumbersome heat-transfer equations relating to moving heat sources encountered in welding operations. The objective is to provide the welding engineer and designer with a reference that will guide them in making practical use of heat-transfer equations that describe the thermal history at weld heat-affected zones. Solutions for four types of problems are now available: (1) thermal mapping to determine the "temperature hill" enveloping the welding heat source on a semiinfinite plate; (2) determining peak temperatures at some distance from the weld centerline or from the bond line; (3) determining the surface peak temperature at an edge of a plate parallel to the weld; (4) determining the peak temperature on the bottom side of plates having partial-penetration welds. (auth)

53506 URANIUM AS CURRENCY BACKING. Cassuto, Aldo. S. Afr. Mining Eng. J., 78: 818-20(Apr. 12, 1968).

Advantages of using U as an international currency backing to supplement gold are outlined with particular emphasis on benefits to be derived by the South African U industry. (P.G.C.)

53507 AUTOMATIC RETRIEVAL OF NUCLEAR INFORMATION USING PROJECT RESPONSA. Holm, Hans I (Aktiebolaget Atomenergi, Studsvik, Sweden). Tidskr. Dok. (Swed.), 24: 8p. (1968). (In Swedish).

As a result of a charter between Sweden and the United States, data retrieval studies were carried out between December 1966 and March 1967 in Oak Ridge, Tennessee. This RESPONSA project is described in detail in an ORNL report. A brief description of the purposes and results of this project is given. (tr-auth)